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Iron wood Bridge in Ceylon.

J. Tirebird 273 Strand 1834

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OR, AN

ANNUAL REGISTER

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USEFUL INVENTIONS AND IMPROVEMENTS, DISCOVERIES AND NEW FACTS,

IN

MECHANICS, CHEMISTRY, NATURAL HISTORY, AND SOCIAL ECONOMY;

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THE scientific industry and stirring enterprise of the past year, have furnished another volume of *Arcana*, which, it is hoped, will be found equal in valuable and entertaining details to either of its predecessors. Indeed, if the maxim, "practice makes perfect," hold good in editorship, it follows that the present volume should be superior to its fore-runners; since the history of science during the last twelvemonths abounds with facts of more striking and important character than any similar period within the Editor's experience.

In the *Mechanical* division will be found many valuable improvements in Steam Navigation, and notices of the year's progress in the application of Steam Carriages on common roads; Mr. Saxton's Railway with Differential Pulleys, described and illustrated; an outline of Ericsson's Caloric Engine; and the Railways in progress and projected in England: the economy of Biscuit-baking Machinery; an important paper by Mr. Galloway on the Steam expansion principle, and the Cornish Engines; Glass balance-springs for Chronometers described; Rutter's New Heat Process; a suggested improvement in Barker's Mill; the power of American Steam Boats; Bate's improved Medal-ruling process; and an abridgement of the recent Survey of Blackfriars-Bridge.

To these is added a selection from the Patents sealed during the year, in which main assistance has been derived from that respectable Journal, "the Repertory of Patent Inventions."

In *Chemical Science* are the new phenomena of Electro-Magnetism; patent processes for Gas-lighting; Dr. Davy's valuable paper on Phosphorus; a contribution to entertaining science, by Professor Faraday, on Holding the Breath for a lengthened period; the details of a Prepared Charcoal Filter; Glass Syphons for Corrosive Fluids, and Professor Daniell's New Oxy-hydrogen Jet; an examination of the nature and properties of Meteoric Iron; Professor Hare's improved apparatus for the Evolution of Boron; Analyses of the Rio Vinagre, of Opium, Carmine, Camphor, and certain volatile oils; some newly observed properties of Colour; and Sir Henry Halford's curious researches on the Poisons of the Ancients.

In *General Science* will be found a condensed report of the year's Meeting of the British Association, at Cambridge; Professor Babbage's projected Constants of Nature and Art, a proposition worthy of the reader's most attentive perusal: and a paper of suggestions of practical utility on Scientific Education, by Professor Ritchie.

The *Naturo-historical* departments include not a few entire

papers and abstracts of popular interest. In *Zoology* is an invaluable contribution to Ornithology, in a paper on the economy of Northern Birds, by Frederic Faber; an investigation of the opinions on the alleged Circulation in Insects, by Professor Rennie; some welcome facts in the natural history of the Nightingale; Professor Baer's new view of the Formation of Pearls; a paper by Tiedmann, on the Reproduction of Nerves; Dr. Knox's Natural History of the Salmon; Professor Wagner's laborious efforts to ascertain the Numerical Relations of Animals, and a paper of kindred interest by a distinguished English Naturalist, on the probable Number of Species of Insects; Illustrations of some Zoological rarities, as the Sigalion Boa, Squilla Desmarestii, Sabella Amœna, &c.; the habits of the Tarentula; Humboldt, on the Light of the Sea; Professor Buckland, on the Anatomy of the Sloth; M. Fleurens's new view of the process of Rumination; and further Observations on the Black Pulp Leech; with about ten pages of Notes from the Proceedings of the Zoological Society during the year; including notices of New Mammalia and Birds, and Additions to the Menagerie and Museum.

In *Botany* are illustrated Notes from Professor Lindley's Lecture on Mildew; Biots' Researches on the Inflammation of Fraxinella; and Dutrochet's New Observations on the Directions of Stems and Roots.

In *Geology* is a digest of Boussingault's paper on the Hot Springs of the Andes; Sir David Brewster's Researches on the Origin of the Diamond; and Mr. Hutton's valuable Observations on Coal. The *Fossil Organic Remains* include the Plesiosaurus at Bedford; Coal and Fruits at Billesden Coplow; a Lily Ecrinite in the limestone of Cork; and a retrospect of the splendid discoveries of the year 1832.

Among the *Astronomical* and *Meteorological* abstracts are Arago's Observations on the Moon; a remarkable Deposition of Ice, illustrated by Sir John Herschel; Dr. Prout, on the weight of the Atmosphere during Cholera; an outline of Capt. Ross' Discovery of the North Magnetic Pole; and the Meteorological Summary of the year, again obligingly furnished by Dr. Armstrong.

The contributions to *Rural Economy, Gardening,* and *Miscellaneous Arts* are recommended by novelty and usefulness, and illustrate improvements in these branches of social improvement, upon scientific principles.

The Editor has only to add his assurance of impartiality in the adoption of such of the year's materials as in his humble judgment are best calculated to represent its improvements; and to the reader's candid appreciation he unhesitatingly submits his Seventh Annual Register of Science and Arts.

London, Feb. 15, 1834.

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Page 309—Note to Mr. Galloway's Paper on the Cornish Steam Engines, at 41 to 47.

ERRATA.

At page 179, for the Second Meeting of the British Association, read *Third* Meeting, &c. The Report of this Society appears, by an inadvertence, under Mechanical Inventions, instead of under General Science.

M. Boussingault's paper on the Hot Springs of the Andes appears both under the divisions of Chemical Science and Geology—though, in the latter instance, with additional geological details.

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ARCANA OF SCIENCE,

&c.

MECHANICAL INVENTIONS.

SATIN-WOOD BRIDGE IN CEYLON.

(*See the Frontispiece.*)

This bridge has recently been thrown over the Mahavillaganga river, at Peradenia, in Ceylon, the richest and most extensive of all the islands appertaining to British India. It was designed and set up under the superintendence of Lieut.-Colonel Fraser, deputy quartermaster-general of the forces in Ceylon, and, independently of its interest as a novelty in bridge-building, it must be regarded as a gratifying specimen of British skill in the improvement of our colonial possessions.

The bridge consists of a single arch, (principally of satin-wood,) of 225 feet span, or half as wide again as the centre arch of London Bridge. The roadway is twenty-feet wide, and its height above the river at low-water mark about sixty-seven feet. The arch is composed of four treble ribs transversely distant from each other five feet from centre to centre. The sum of the depths of these ribs is four feet, which, with two intervals of two feet each, make the whole depth of the arch eight feet.

The beams of which the arch is built are, with the exception of those next to the abutments, from sixteen to seventeen feet in length, and twelve inches thick. They abut against each other with an unbroken section, and are secured at the joints by the notched pieces which support the road-way: the latter being held in their position by means of cross-ties both below and above the arch and immediately under the roadway. These cross-ties, with the aid of diagonal braces, which are also locked into them, serve to give stability and firmness to the whole structure.

According to the original design, no material but timber has been admitted into the construction of the arch. The arch was commenced in the middle of July, 1832. The centering was struck on the first of October, and the roadway was completed before the first of January, 1833.

Wooden bridges, generally, are condemned as being com-

posed of a very perishable material, but on the principle on which this is constructed, the different parts of the arch may be replaced as they decay. The American wedge bridge is said to be exceedingly flexible: but this has been completely obviated in the bridge at Peradenia.*

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

THE third meeting of this Association was held at Cambridge, on June 24, and continued through the week. The plan of the proceedings was substantially the same as in former years: the following were the Provisional Committees of the Sections:—

1. *Mathematical and General Physics.*—Chairman, Sir D. Brewster; Deputy Chairman, Rev. G. Peacock; Secretary, Professor Forbes:- Lord Adair, Professor Airy, Professor Babbage, Mr. F. Baily, Mr. Barton, Professor Barlow, Mr. Blackwall, Mr. Bowstead, Sir T. M. Brisbane, Professor Christie, Rev. H. Coddington, Mr. Cooper, Dr. Corrie, Mr. Dollond, Lieutenant Drummond, Mr. D. Gilbert, Rev. R. Gerswell, Professor W. R. Hamilton, Hon. C. Harris, Mr. G. Harvey, Sir John F. W. Herschel, Mr. E. Hodgkinson, Mr. Hymers, Professor T. Jarrett, Dr. Lardner, Mr. Lubbock, Mr. R. Murphy, Mr. Philpott, Mr. R. Potter, jun., Professor Baden Powell, Mr. Quetelet, Professor S. P. Rigaud, Dr. Robinson, Rev. R. Walker, Mr. W. L. Wharton, Mr. C. Wheatstone, Rev. W. Whewell, Rev. R. Willis.

2. *Chemistry, Mineralogy, &c.*—Chairman, Dr. Dalton; Deputy Chairman, Professor Cumming; Secretary, Professor Miller:—Mr. Thomas Allan, Professor Daniell, Professor C. Daubeny, Professor Faraday, Rev. W. V. Harcourt, Mr. Snow Harris, Mr. J. F. W. Johnston, Mr. Marshall, Mr. Pearsall, Mr. Richard Phillips, Dr. Prout, Professor W. Ritchie, Rev. W. Scoresby, Mr. W. Sturgeon, Professor Turner.

3. *Geology and Geography.*—Chairman, Mr. G. B. Greenough; Deputy Chairmen, Rev. Dr. Buckland and Mr. R. I. Murchison; Secretaries, Mr. William Lonsdale and Mr. John Phillips:—Dr. Boase, Mr. James Bryce, jun., Mr. Joseph Carne, Major Clerke, C. B., Rev. W. D. Conybeare, Sir Philip de M. G. Egerton, Dr. Fitton, Rev. Professor Hailstone, Mr. G. Mantell, Lieutenant Murphy, R. E., Marquis of Northampton, Professor A. Sedgwick, Colonel Silvertop, Mr. William Smith, Mr. J. Taylor, Mr. W. C. Trevalyan, Mr. H. T. M. Witham, Rev. J. Yates.

4. *Natural History.*—Chairman, Rev. W. L. P. Garnons; Deputy Chairman, Rev. L. Jenyns; Secretaries, Mr. C. C. Babington and Mr. D. Don:—Mr. Agardh, Mr. Blackwall, Mr. W. J. Burchell, Professor Burnett, Mr. W. Christy, Mr. Allan Cunningham, Mr. J. Curtis, Mr. E. Forster, Mr. J. E. Gray, Professor J. S. Henslow, Professor Lindley, Mr. Ogilby, Dr. J. C. Prichard, Mr. J. Sabine, Mr. Selby, Mr. R. Taylor, Mr. W. G. Werscow.

5. *Anatomy, Medicine, &c.*—Chairman, Dr. Haviland; Deputy Chairman, Dr. Clark; Secretaries, Dr. Bond and Mr. Paget:—Dr. Alderson, Sir C. Bell, Professor Burnett, Mr. Broughton, Mr. Clift, Mr. Dugard, Mr. H. Earle, Dr. Marshall Hall, Dr. Hewett, Dr. Jermyn, Dr. Mal-

* The dimensions from the Journal of the Royal Geographical Society.

cavey, Dr. Macartney, Professor Mayo, Dr. Paris, Dr. Prout, Dr. Roget, Dr. Thackeray, Dr. A. T. Thomson, Dr. D. Thorp.

A discussion was commenced in the physical section in the morning, and resumed at a general meeting of the Association in the Senate-house in the evening, on the phenomena of shooting stars and of the aurora borealis; in which Dr. Robinson, of Armagh, Dr. Dalton, Sir John Herschel, Professor Airy, Mr. Scoresby, Mr. Whewell, Professor Christie, and Mr. D. Gilbert, engaged. It was stated by some that the aurora was never elevated more than from three to seven miles above the earth's surface; while others contended that its altitude was ninety or a hundred miles: this discrepancy led to an earnest recommendation that the phenomena should be more carefully and accurately observed.

June 25.—At eleven and twelve, meetings of the sections were resumed in the Schools and Caius College Hall, for receiving and discussing communications, &c. The following were the subjects examined respectively in the appropriate sections.

Remarks on certain Atmospheric Phenomena, observed at Hull, in March and April, 1833. By G. H. Fielding, Esq.

On Naval Architecture. By J. Owen, Esq.

An Account of some Experiments relating to Isomorphism, undertaken at the request of the Association, by Dr. Turner and Professor Miller.

A communication was made by Dr. Daubeny, on the Nature and Quantity of the Gases given off the Surface of the Water in certain Thermal Springs.

Mr. John Taylor exhibited Sections of the Shafts of the Deepest Mines, and gave some particulars respecting them.

Observations relative to the Structure and Functions of Spiders. By Mr. Blackwall.

Observations on the Pith of Plants. By Professor Burnett.

Observations on the Structure and Functions of the Nervous System, by Dr. Macartney, of Dublin, who detailed a considerable number of highly interesting and important original facts.

Professor Buckland took the chair, and resigned the office of President to Professor Sedgwick, who proceeded to address the Meeting at considerable length. He announced that Mr. Whewell had at his request prepared a review of the Reports on the progress and present state of various branches of science, which had been presented at the Meeting of last year: he noticed summarily the publication of those Reports, and the contents of some of them, dwelling particularly on those of Mr. Whewell's own Report on the Progress of Mineralogy: and, finally, announced that His Majesty and the Government, wishing to manifest their attachment to science, and to confer some mark of royal favour upon an illustrious philosopher, have confered upon Dr. Dalton a pension out of the Civil List.

Mr. Whewell then addressed the assembly at great length, in reference to the objects of the Association, and read his exposition of its preceding transactions. This he subsequently printed, and presented to the Members.

It was then moved, "That the persons whose names had been enrolled by the Committee since the last Meeting, be elected Members of this Association;" and "That the Council shall have authority to elect Members of this Association; each case being subject to the approbation of the next General Meeting."

The Association met again in the evening, when Mr. John Taylor read a Report on the subject of Mineral Veins; in which he went largely into the history of the science, and the different theories which have been propounded by philosophers on this subject. There are three leading hypotheses: first, that which supposes metallic veins to have been open fissures, caused by some eruption, and filled up with various matters, by aqueous solution, from above; the second theory is, that these fissures were formed by violence done to the strata, and filled up by matter from within the earth, forced up by heat, and becoming a mineral substance; the third theory is, that the whole formation was contemporaneous with the rocks themselves. Each of these theories was investigated in the Report, and became the subject of an animated discussion, in which Dr. Buckland, Professor Whewell, Dr. Boase, Mr. John Phillips, and Mr. Fox, severally took part. The learned Chairman summed up and the Meeting adjourned.

June 26.—At the Sectional Meetings the following communications were read:—

Mr. Potter on the Action of Glass of Antimony on Light.

Account of a Barometer Cistern. By Mr. Newman. Communicated by Mr. Willis.

Account of a New Reflecting Telescope. By Thomas Davison. Communicated by Mr. Turner.

Professor Oersted on the Compressibility of Water.

A communication on the Specific Gravity of Gases. By Dr. Dalton and Dr. Prout.

An account of the Experiments relative to the Sulphur Salts.

Dr. Turner gave an account of his Experiments on Atomic Weights.

Dr. Daubeny read a Memoir on the Action of Light on Plants, and on the Action of Plants on the Atmosphere.

Mr. Trevelyan exhibited Specimens of Coprolites and Fossil Fish.

Mr. Murchison exhibited the Ordnance Maps, geologically coloured by himself, of the counties of Salop, Hereford, Radnor, Brecon, and Carmarthen, accompanied by enlarged sections; and explained the mineral structure of the county described.

A paper containing some Observations on Genera and Sub-Genera. By Mr. Jenyns.

On the Water contained in Bivalve Shells. By Mr. Gray.

Observations on the Classification of Ruminating Animals. By Mr. Ogilby.

Notice of a Memoir on the Natural Laws which appear to regulate the Distribution of the various powers of producing Heat and Light among the different groups of the Animal Kingdom. By Mr. Brayley.

Observation on the Motion and Sounds of the Heart.

Observations, by Mr. H. Earle, on the Mechanical Functions of the Bulb of the Urethra.

Illustrations of the Effects of Irritant Poisons on Mucous Surfaces.

At the General Meeting, the President having taken the chair, the different Chairmen of the Sections read the Reports of their Proceedings; after which, Mr. Peacock read a paper on the recent progress of the Integral and Differential Calculus; Professor Lindley his Report on the principal questions debated in the Philosophy of Botany; and Mr. Rennie a paper on Hydraulics, considered as a branch of Engineering.

June 27—At the General Meeting, the President in the chair, it was moved by Dr. Buckland, and seconded by Mr. John Taylor, "That the

gentlemen whose names were enrolled by the Committee yesterday be elected Members of the Association."

Mr. John Taylor, having been called upon by the President, gave a statement of the finances and numerical strength of the Association—of which the following is an abstract:—

	£.	s.	d.
Total Receipts - - -	1,430	0	0
Disbursements - - -	186	4	4
	£1,243	15	8

The number of Members when the meeting was commenced was 680, but a greater number had joined since. If the rough numbers were correct, the number of new Members would amount to 689 at Cambridge; —total number of Members, 1,369. There will be about 1,000*l.* more to be received; and, after paying the expenses of this meeting, a balance will remain of about 2,000*l.*

Professor Henslow invited the Members of the Association to an excursion in a barge on Saturday, to make some botanical and entomological researches in the fens.

The President then called upon the Chairmen of the Sections to make their Reports, which were given by the respective gentlemen.

Professor Christie then read a Report on Magnetism; in which he considered, first, the direction of the terrestrial magnetic force; and, secondly, the intensity of the magnetic force. In the course of this Report, the learned Professor regretted that this was the only country in Europe in which observations on this important science were not made in a national observatory.

Mr. Whewell then delivered a Report on the knowledge we have of the strength of materials; in which he entered into the history of that science, and presented a variety of facts in illustration of his subject; after which the meeting adjourned.

A numerous auditory again assembled in the Senate-House this evening, the several Sections being engaged in their different departments. At about ten o'clock Professor Sedgwick took the chair.

Mr. Whewell delivered an exposition of his recent researches relative to the Tide-wave, illustrating them by reference to Maps which he had constructed for the purpose.

Professor Farish addressed the meeting on the subjects of Railways and Steam-carriages.

June 28.—The several Sections met as usual at ten o'clock; and at one o'clock the last public meeting of the Association was held in the Senate-House.

The Reports of the Sections were then presented by the respective Chairmen.

Mr. Challis read a paper on the Theory of Fluids; in which he treated of the leading hydrostatical and hydrodynamical problems; the latter of which chiefly occupied his attention, and which he divided in the following manner:—1st, the motion of fluids in vessels and pipes; 2nd, the determination of the velocity of the propagation of motion in air; 3rd, the musical vibrations of the air; 4th, the theory of waves; 5th, resistance to a ball pendulum, supposing it to oscillate in a small degree.

The President announced that, since the preceding day, among the names which had been enrolled by the Committee were the names of the illustrious Dr. Chalmers, Professor Jameson, and Dr. Henry, sen., of

Manchester; on each of whom he passed a high eulogium, and who were then elected Members of the Association by acclamation.

He then stated that the meeting for 1834, would take place at Edinburgh, in the month of September, probably in the early part of it.

It was afterwards announced that Sir Thomas Brisbane was the President elect; Sir David Brewster and Dr. Robinson the Vice-Presidents; the Rev. W. V. Harcourt, and Mr. Phillips of York, General Secretaries; Mr. John Taylor, Treasurer. Dr. Robinson and Professor Forbes, Secretaries for Edinburgh; and the Rev. W. Whewell and Professor Henslow, Secretaries for Cambridge.

Professor Babbage next addressed the meeting on the subject of his proposal for collecting and publishing the numerical quantities which he has termed "the Constants of Nature and Art."*

Mr. Brunel, Earl Fitzwilliam, the Rev. W. Scoresby, the Marquess of Northampton, the Rev. Dr. Lloyd, the President, Professor Buckland, Professor Hamilton, Professor Airy, Mr. Murchison, and the Rev. W. V. Harcourt, having severally addressed the assembly, this Third Meeting of the British Association for the Advancement of Science was then dissolved by the President.

CALORIC ENGINE.

Mr. Ericsson has recently patented a new mechanical power, which he calls his "Caloric Engine," of which the *Nautical Magazine* reports as follows:—We have had an opportunity of inspecting this invention, and it appears to us likely to supersede in a great measure the use of those engines in which the power is obtained from steam, particularly in vessels and locomotive carriages. The remarkable distinction between this engine and the steam-engine consists in a process of transfer, whereby the heat required to give motion to the engine at the commencement is returned, and made to act over and over again, requiring but a small quantity of heat to be continually added. This novel application of heat, whereby an almost unlimited quantity of mechanical power may be obtained from a small quantity of fuel, is founded on the well-known property of heat whereby the temperature is *equalized* between substances, however *unequal* in their *densities*.

The patentee does not confine himself to any particular impelling agent, for various aeriform, or even fluid substances, may be used; but the engine we have seen in operation is worked by *atmospheric air*. The working cylinder is fourteen inches in diameter, with eighteen inches stroke, working under a pressure of thirty-five pounds to the square inch, and making fifty-six strokes per minute.

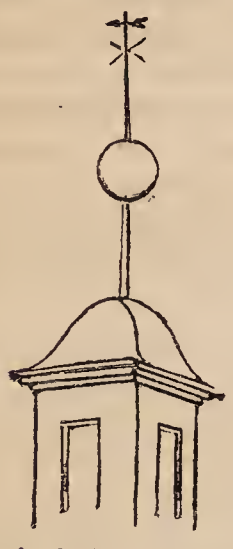
The apparatus by which the transfer of the heat is effected, and which the inventor terms the "Regenerator," is five feet six inches long, and eight inches and a half in diameter, and containing seven tubes of two inches diameter each; and its operation is so perfect, that all the heat lost, that is, heat not returned to the engine, does not amount to more than three pounds per hour. The total consumption of fuel is, however, nearly two

* See page 163 of the present volume.

pounds per horse's power in the hour, on account of a considerable radiating surface being exposed to the atmosphere without any nonconducting covering. The power of the engine (equal to five horses') is checked by a break, loaded with 4,000 lbs. weight, acting on the circumference of a wheel of two feet diameter, fixed on the fly-wheel shaft.

TIME BALL ON THE GREENWICH OBSERVATORY.

This useful apparatus has been placed on the cupola of the eastern turret of the royal observatory, and consists of a ball, about five feet diameter, which is perforated by a pole about sixteen feet high, at the top of which are four arms with letters set to the cardinal points; the N bearing exactly on the stone pillar which has been erected for the observatory, on Hawk Hill, Chingford, Essex. The whole is surmounted by an arrow vane. At five minutes before one o'clock, P.M. every day, the ball is drawn half way up the pole, as in the first cut. At two minutes before one, it is raised to the top close under the arms; and at one o'clock, mean solar time, it falls to the bottom of the pole where it remains twenty-four hours. The ball is dropped by one of the gentlemen of the observatory touching a spring which acts instantaneously. The injury likely to occur from the sudden fall of the ball is counteracted by means of the compression of air in an iron piston. The whole contrivance is stated in the *Nautical Magazine*, to be the proposal of Captain Wauchope, R.N.



(Five min. before 1 o'clock.)

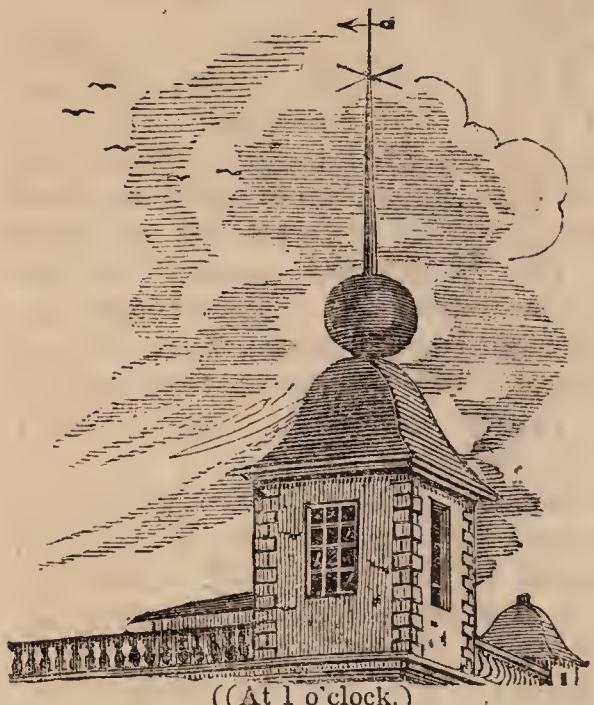
(At 2 minutes before 1 o'clock.)

The following is the official notice, issued from the Admiralty, respecting the operation of the apparatus:

"The Lords Commissioners of the Admiralty hereby give notice, that a ball will hence-forward be dropped every day from the top of a pole of the eastern turret of the Royal Observatory, Greenwich, at the moment of one o'clock, P.M. solar

time. By observing the first instant of its downward movements all vessels in the adjacent reaches of the river, as well as in most docks, will thereby have an opportunity of regulating and rating their chronometers. The ball will be hoisted half way up to the pole at five minutes before one o'clock as a preparatory signal, and close up at two minutes before one."

"Thus, by a telegraphic signal, the instant of noon at the British Observatory is made known to all whom it may concern. The value of this knowledge must be evident to those who are conversant in nautical astronomy or geography; and are aware that the meridian of Greenwich is the point from which longitudes are calculated east or west of that place in all English scientific books and naval charts. A somewhat similar plan has been followed for many years by the government observatory at Copenhagen, where a flag is hauled down when the sun has attained its meridian altitude; but the use of a ball or globe of large diameter, as now adopted at Greenwich, is far preferable, as it will be alike visible on all sides and at all times, whether the wind blow light or strong."



((At 1 o'clock.)

STEAM CARRIAGES ON COMMON ROADS.

During the last twelve months much has been done in maturing the application of steam conveyance on turnpike roads.

Mr. Hancock's carriage has run several times between London and Paddington, and Stratford; and a new carriage constructed by him has been on short experimental journeys from Finsbury Square. Mr. Hancock has also twice made the journey to Brighton, but not without accidents, nor has he been able to accomplish a long journey in advantageous time.

Messrs. Macerone and Squire's carriage has, in addition to several short distances, performed two journeys between London and Windsor, in such a manner as materially to advance the cause.

Probably the most important evidence of the year has been furnished by Sir Charles Dance's journey to Brighton and back to London—this being the first long journey that has been accomplished by a steam coach on a common road, without a breakage of some of the parts.

The steam-carriage consists of two high-pressure engines seven inches in diameter, and sixteen inches stroke, fixed horizontally on the carriage, the piston-rods actuating a two-throwed crank which forms the main

axle of the hind driving wheels, the front wheels having a locking motion similar to an ordinary horse coach, for the purpose of causing the carriage to perform any curve for turning. On to the locking machinery is affixed a toothed rack, which is actuated by a toothed pinion on a vertical rod passing up in front of the carriage, having four handles, and according as these are moved to the right or left, so will be the course taken by the carriage. Over the hind or driving wheels is placed the boiler, which consists of an ingenious arrangement of tubes, the invention of Sir Charles Dance and Mr. Field, (since patented) and this forms the main feature of the carriage. This carriage only performs the part of a steam-horse or drag, the passengers, &c. being conveyed by a separate carriage.

The journey to Brighton was completed in	6	22	16
Deduct stoppages	1	6	0
Actual time of running.....	5	16	16
The return from Brighton occupied	5	55	30
Deduct stoppages for coke and water		66	0
Actual time of running.....	4	59	30

The same carriage ran eight successive days from London to Greenwich three times a day, or in the whole 250 miles, at an average running of ten miles per hour. And on Nov. 1, started on an experimental journey upon the Mail-Coach Line of the Holyhead Road; and, although the carriage from various causes proceeded no further than Stoney Stratford, or 52½ miles, its rate averaged seven miles per hour. A report of this journey states, "there can be no doubt, that with a well constructed engine of greater power, a stem carriage conveyance between London and Birmingham, at a velocity unattainable by horses, and limited only by safety, might be maintained;" signed by Mr. Telford, Pres. Soc. Civil Engineers; Mr. Rickman, Sec. and Com. Highland Roads and Bridges; Lieut. Col. C. W. Pasley, Commanding the Royal Engineers, Chatham; Messrs. Donkin, Bramah, Thomas, Field, Macneill, Gordon, Carpmael, and Simpson, Civil Engineers.*

The following list will likewise show that the spirit of scientific enterprise has been stimulated by the experience of the past year. It enumerates the steam carriages built and now building in London and its vicinity.

Dance, three sent to Cheltenham.
——— and Field, one repaired and new boiler.
Frazer, a carriage, himself and others, building, an experimental one.
Gatfield and Bower, a drag, themselves, experimental one, building.
Gibbs and Applegath, a drag, themselves, experimental one, built.
——, an experimental carriage to try new boiler.
Gurney, four, experimental.
Hancock, Infant, his own, built, an experimental one.
————, Era, for a company, built.
————, Enterprize, for a company, built.
————, Autopsy, his own, built.

* These facts are chiefly obtained from a well timed pamphlet—"A Concise History of Steam Carriages on Common Turnpike Roads," &c. Simpkin and Marshall.

Hancock, a new one, his own, now building.
Manting, Joseph, a carriage, his own, experimental one, building.
Maudslay, one, building.
Mile End, name not known, a carriage, for a company, experimental one.
Ogle, a carriage, his own, built, experimental one.
Palmer, a drag, his own, experimental one, built.
Phillips and Co., a carriage, their own, experimental one, building.
Redmund, a carriage, experimental one, building.
Silk, a carriage, his own, experimental one, building.
Smith and Co., a carriage, for a company, experimental one, building.
Smith (Andrew,) a drag for Mr. King, experimental one, building.
Squire, a carriage, for himself and others, experimental one.*

THE MONSTER MORTAR OF ANTWERP.

The idea of constructing this mortar of gigantic magnitude originated with the celebrated Colonel Paixhans, of the French artillery. It was cast at the Royal Foundry at Liege, under the direction of Baron Evain, the Belgian Minister of War. It was 4 feet 11 inches long, 39½ inches in diameter, and 24½ inches in the bore, and weighed 14,700 lbs. The weight of the empty shell was 916 lbs.; of the powder contained in the shell 99lbs.; of the shell, when full charged, 1,015 lbs. The powder-chamber was made to hold 30 lbs.; but a considerably less quantity than this sufficed to discharge the shell when the range did not exceed 800 or 900 yards. The weight of the wooden bed which contained the mortar was 16,000 lbs.

Fig. 1.

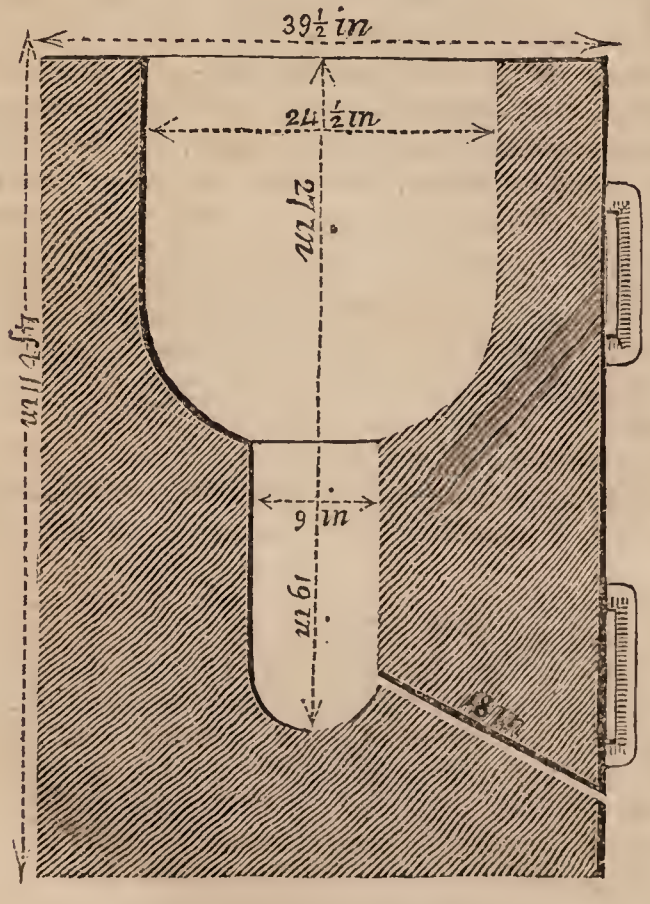


Fig. 1 is a section of the mortar; and fig. 2 another of the shell, with the charge and fuse.

The name of "Monster Mortar" was well selected, for it is scarcely possible to conceive a more ugly or unwieldy imple-

*From the Repertory of Patent Inventions, &c., No. 1., Jan. 1834.

ment. With the exception of the mortar at Moscow, the bore of which is 36 inches in diameter, and which, if ever used, must have been employed for projecting masses of granite, the "Monster Mortar" exceeded in magnitude any other engine of the kind hitherto known. The immense pieces called *Karthauns*, which were common on the Continent in the early part of the 18th century, rarely exceeded between 70 and 80 cwt., and projected a ball of not more than 60lbs. weight.

It was conveyed from the foundry at Liege, on a carriage made for the purpose, to the heath of Braeschaet, near Antwerp. On the day after, a preliminary trial of it took place in the presence of a number of French and Belgian officers. Previous experiments made with it at Liege had not succeeded, either owing to some defect in the shell, or in the mode of firing. It had been tried with the usual wooden sabot as well as with a wad of twisted straw, but, with one or two exceptions, the projectile burst at the moment of quitting the piece. This was attributed to a want of thickness in the shell, particularly of the culot, or part coming in contact with the charge, which, from the great diameter of the cavity had not sufficient thickness to resist the shock of the powder and concussion of the air. Fresh shells were directed to be cast, in the proportion shown in fig. 2. Eight or ten experiments were first made with the dead shell, filled with its proper weight in sand, and fired with various charges, from 6 to 12 lbs. gradually increasing. No accident occurred. The artillery officers being satisfied with these trials, the shell was loaded to a third, and so on to its full charge, upwards of a barrel and a quarter. Only one shell out of six burst at the mouth of the piece; the remainder fell near the target, and exploded with a fierce detonation, tearing up many cubic feet of earth, and scattering splinters to the distance of 450 yards. The shells were hoisted to a level with the mouth of the cylinder by means of a chevalet (tressel), supporting a swivel-bar, on the one end of which were suspended two chains with hooks to catch the rings of the shells, and on the other a weight nearly equalling that of the projectile; it was easily raised by this means, and then lowered, without any jar, into the chamber. A straw-twisted wad was employed as a sabot. The operation of loading required on an average from 37 to 50 minutes. The vent was fitted with a spring detonator, and the man who fired stood behind a traverse, and pulled the string with a long cord.

Fig. 2.

The efficiency of the mortar having been thus satisfactorily determined, it was resolved to convey it into Antwerp, and to place it in battery against the citadel. Eight horses were required

to draw the carriage on which it was placed, and eight others to draw the carriage containing the bed. The station selected for the mortar was close by the Malines-gate, and within 800 yards of the Fernando bastion of the citadel.

At midnight of the 21st and 22nd of December, the mortar was loaded with 12½ lbs. of powder, and the first discharge took place. The shell was watched with extreme anxiety as it made its parabola, and a look-out person, stationed on the tower of St. Andre (in the city), reported that it had fallen and exploded near the great powder-magazine, at the gorge of the bastion Fernando. At the second shot, which took place nearly an hour later, the shell burst on issuing from the mouth of the mortar, not by explosion of the fuse, but from the weakness of the projectile itself. Great care was, therefore, ordered to be taken to select others with thicker culots. The mortar was fired at intervals during the following day, and the shell was then easily to be traced in its progress from the mouth of the mortar. In the air it had the appearance of a huge cricket-ball, and seemed to have but little velocity. On the 23rd, there was, fortunately, no farther occasion for the use of this tremendous instrument of destruction. It has, however, since burst during an experiment. It had been three times charged; first with 21, then with 17, and afterwards with 15 kilogrammes of powder; and it was ascertained that the shell was projected to the same distance and with the same force with the smaller as with the greater quantity. On being fired the fourth time, it was charged with only 9 kilogrammes of powder; but probably being too closely rammed, it split in two, throwing a piece of iron, weighing 3,000 kilogrammes, or nearly 6,107 English pounds, to a distance of above 20 feet. Happily no one was wounded.*

RAILWAY WITH DIFFERENTIAL PULLEYS.

(*See the Plate.*)

This invention, which in importance and interesting character, may challenge comparison with any improvement of the past year, is the work of Mr. Joseph Saxton, of Sussex-street, Middlesex. It consists in the application of pulleys of different diameters, which the inventor denominates "The differential Pulleys," or of a pulley and wheels, according to the principles hereafter described, whereby he is enabled to take advantage of the results which are obtained from such difference of diameter, by obtaining considerable velocity to carriages, or to vessels used in inland navigation, whilst the rope by which the motion is produced, is caused to act through a very small space, in proportion to the distance travelled by the carriage, or a vessel. The inventor enters into a short description of the principles of

* Abridged from the United Service Journal, and the Mechanics' Magazine.

Taxton's Impts. in Propelling Carriages & Vessels.

Fig. 2.

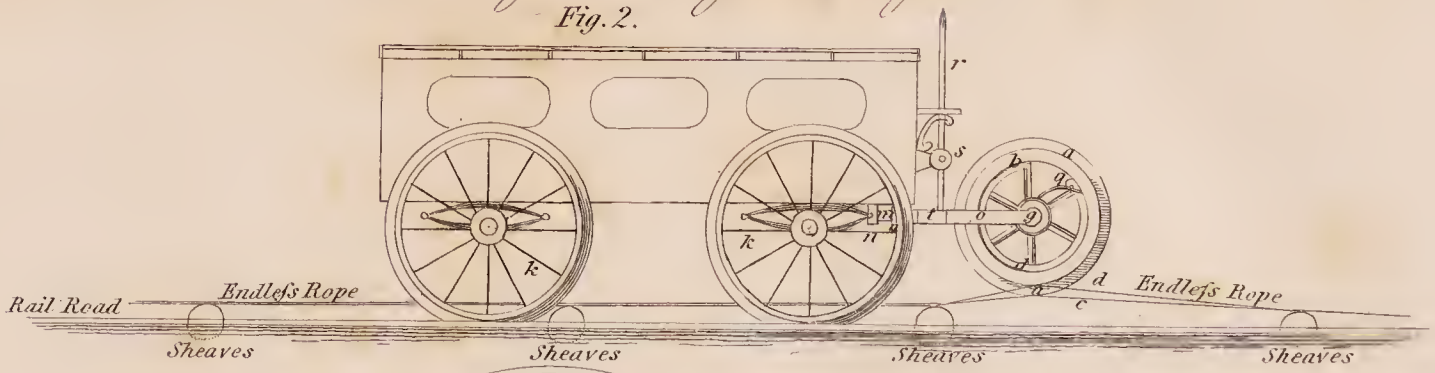


Fig. 3.

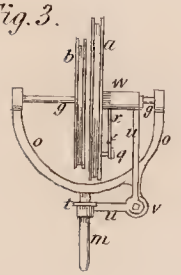


Fig. 1.

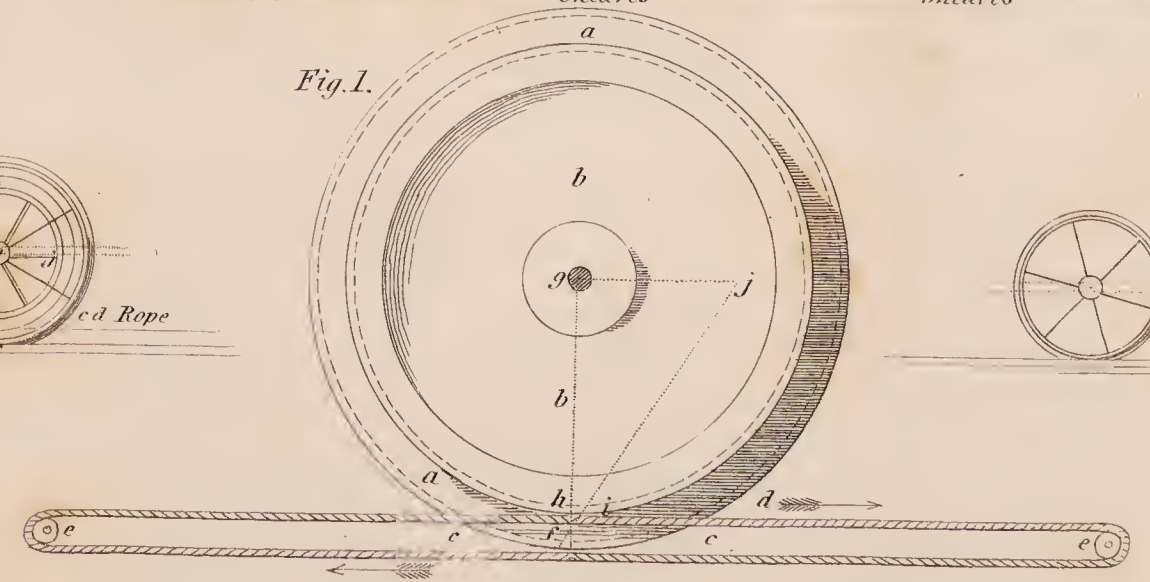


Fig. 4.

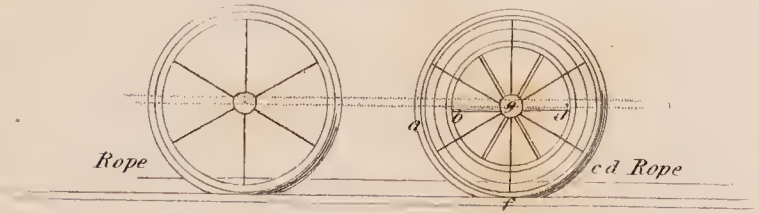


Fig. 5.

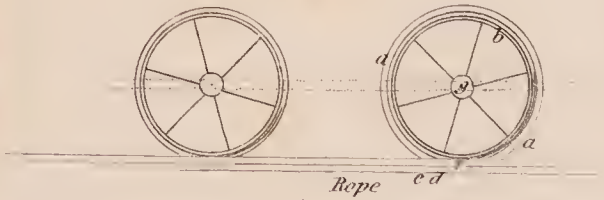


Fig. 7.

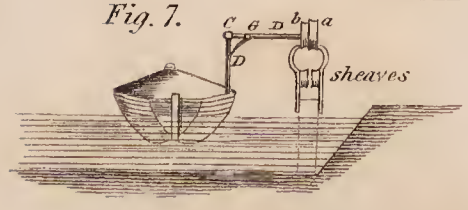
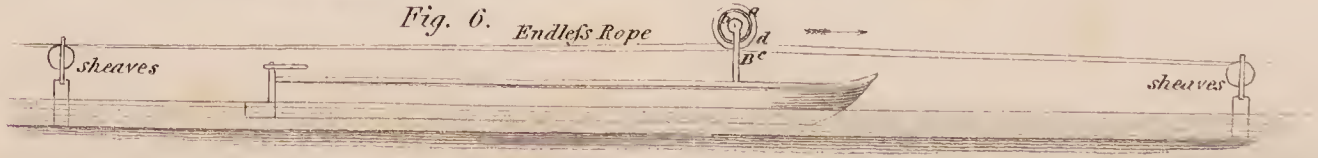


Fig. 6.

his improvements, before describing their application to carriages, and to vessels for inland navigation.

Description of the Engraving.

Fig. 1, represents a combination of two pulleys, their diameters being as six to seven, *a*, being the larger pulley, and *b*, the smaller one. *c*, *d*, is an endless rope, passing over the sheaves *e*, *e*; this endless rope taking a turn around each of the pulleys *a* and *b*; that is to say, the part *c*, taking a turn around the larger pulley *a*, and the part *d* taking a turn around the smaller pulley *b*. If then the rope *d*, be caused to move in the direction of the upper arrow, it will have a tendency to draw the lower part of the pulley *b*, in the same direction with the rope *d*; meanwhile the part *c* of the endless rope will be moving in the direction of the lower arrow, and will have a tendency to move the lower part of the pulley *a*, in the same direction with this part of the rope; consequently, the two pulleys *a*, *b* (they being fixed together), would turn on the mean point *f*, as a fulcrum. *g*, is the centre of the two pulleys. Let it then be supposed that the part *d*, of the endless rope be moved from *h* to *i*, it will be evident that the centre *g*, of the differential pulleys *a*, *b*, would be moved to the point *j*; and consequently, if any object were connected to the centre *g*, of these differential pulleys, it would be propelled from *g*, to *j*, by the endless rope *c*, *d*, being moved the much smaller distance of *h* to *i*, as is clearly indicated by the dotted lines; these distances will be as thirteen to one.

Having now shown the principles on which the differential pulleys act, the various applications hereafter described will be readily understood; in the drawing, the same letters of reference being used to indicate similar parts, wherever they occur.

Fig. 2, represents the improvements applied to a carriage, for example, an omnibus for the carriage of passengers, placed on four wheels, as usual, two of which wheels, *k*, *k*, are shown in this figure. *a*, and *b*, are the differential pulleys applied to the carriage, *a*, being the larger pulley, and *b*, the smaller one. These pulleys are placed on an axis *g*, see fig. 3, which represents the pulleys, together with the parts in which they are placed. *m* is an arm or frame, which carries the differential pulleys, and which is fixed to the carriage, as shown at fig. 2: the arm *m* being cylindrical, and capable of turning in bearings *n*, *n*, affixed to the carriage. The object of this turning of the arm *m*, is to permit the pulleys *a*, *b*, to stand at an angle, by which the endless rope may be led into the sheaves, when the carriage is going in a curved direction. The projecting arm *m*, is forked at the outer end, as shown in figs. 2 and 3, at *o*, *o*; and the forked ends serve as bearings to the axle *g*, of the differential pulleys *a*, and *b*, the pulley *a* being permanently affixed to the axle *g*, whilst the pulley *b*, is capable of turning loosely on this axis, when it is not retained by the pin or bolt *q*, which locks the two pulleys *a* and *b*, together at the times required, and thus they are at such times the same as if they were permanently attached to each other; but by disconnecting the two pulleys *a* and *b*, the power will no longer tend to drive the carriage, as will be fully described hereafter. *r*, fig. 2, is a lever, turning on a fulcrum *s*, the bearing of which fulcrum is attached to the carriage. The upper end of this lever *r*, is formed into a handle, and is in such a position, that a person sitting in front of the carriage may have it under his control; the other end of the lever *r*, that is, the part below the fulcrum, has a crotch, which receives the flanch *t*, of a sliding-socket *t*, within it, as shown in fig. 2: this socket slides on the

arm *m*, according as the lever *r*, is moved out from, or is drawn towards the carriage. *u*, is a cranked or bent lever, having its fulcrum at *v*, on the forked frame *m*, *o*, as shown in fig. 3. One end of this cranked lever *u*, has a croth, which receives the flanch *t*, of the sliding socket *t*, see fig. 3; and the other end of the bent or cranked lever *u*, has also a crotch therein, by which it is enabled to slide the socket *w*, on the axis *g*, backwards and forwards. *x*, is an arm, affixed to the sliding socket *w*, through which the bolt or pin *q*, passes, and this pin or bolt also passes through one of the spokes of the wheel or pulley *a*; and when it protrudes beyond the pulley *a*, it passes between the spokes of the pulley *b*, and, consequently, when the pin or bolt *q*, comes in contact with one of the spokes or the part of the inner rim of the pulley *v*, which is cut away (as shown in fig. 2) for that purpose, the two pulleys will be held securely together. On to the bolt *q*, is placed a spiral spring, its object being, that in case the lever *r*, be moved for the purpose of forcing in the bolt *q*, at a time when it is not opposite the part of the inner rim which is cut away, the spiral spring will have a tendency to force in the bolt, yet at the same time will not offer sufficient resistance to prevent the turning of the pulley, and the bolt *q*, will be forced in, when the part of the pulley where it is cut away, comes opposite to the bolt; at the same time there is a spring to prevent a sudden concussion.

In fig. 2, *c*, *d*, is an endless rope, the part *c*, taking a turn around the pulley *a*, and the part *d*, taking a turn around the pulley *b*, as described in fig. 1. This endless rope is supported, at proper intervals of the road, on sheaves (as shown in fig. 2), to prevent the rope falling on the ground, and thereby greatly increase the friction; this endless rope passes around a rigger at each end, and is thus kept sufficiently tight; to insure which, one of the riggers around which the rope passes is placed in bearings capable of being slid in the direction of the length of the railway on which the carriage travels; and then by means of weights attached to a rope or chain, and passing over a pulley affixed at the top of a well, and having sufficient weights attached to keep the endless rope *c*, *d*, sufficiently tight to prevent it sliding on the differential pulleys *a*, *b*.

To understand the manner of the action of the various parts, suppose the bolt or pin is passed through the two pulleys *a* and *b*, and thus retains them together, as if they were permanently fixed to each other. If, then, the endless rope *d*, be moved in the direction of the arrow, a similar action will take place to that described in fig. 1, that is, the carriage being attached to the centre *g*, of the differential pulleys *a* and *b*, will be propelled forward on a railway with a much greater velocity than the rope travels; and the distance so travelled by the carriage, in comparison with the distance through which the rope moves, will depend on the difference of the diameters of the pulleys *a*, *b*; and the nearer the respective diameters of the pulleys approach each other, the greater will be the relative velocity the carriage will travel to the velocity with which the rope moves.

In order to prevent the two parts of the rope rubbing against each other, in leading on and off the differential pulleys, the axis *g*, of these pulleys is placed at an agle, a little varying from a right angle with the direction of the motion of the carriage.

Figs. 4 and 5, show two applications of the improvements, somewhat different from that shown in fig. 2; for in these instances there is only one pulley, whilst the two front or two back wheels of the carriage, act the part of the other pulley.

In fig. 4, *a*, is one of the front wheels of the carriage, which also acts as the larger pulley; *b*, is the smaller pulley, and is the only one around which the rope *c*, *d*, passes; the wheels *a*, and the pulley *b*, being on the same axis *g*, which runs from side to side of the carriage, and turns in bearings affixed to the carriage.

In this arrangement, the point *f*, at which the wheels touch the rail, becomes the fulcrum on which the wheel *a*, turns: and it will thus be evident, that if the rope *c*, *d*, be drawn forward, in the direction of the arrow, a similar effect will be produced, as described in fig. 2, and as is clearly shown by dotted lines in fig. 4; yet, at the same time, if the wheels and pulleys *a* and *b*, be of the same relative diameters as those in fig. 2, the carriage at fig. 4 would only be propelled at the velocity of seven to one, owing to the fulcrum, at which the wheels *a*, turn, being removed from the mean point *f*, fig. 2. between the two diameters, and placed at the extreme end of a radiating line, drawn from the centre of the wheel *a*, to the point at which it touches the railway.

In fig. 5, the rope is passed around the pulley *a*, which is the larger, whilst the carriage-wheels act the part of the smaller pulley *b*; the pulley *a*, and the wheels *b*, being on the same axis *g*.

In order that the pulleys in this arrangement may stand at an angle for clearing the rope, the axle *g*, is formed of three parts, connected by universal joints, and one of the wheels *b*, thus travels a little forwarder than the other, and thus the rope will clear itself. In both these arrangements, the pulley around which the rope passes, is to be made capable of being disconnected from revolving with the axle, as described in figs. 2 and 3. In the arrangement, fig. 5, the fulcrum *f*, on which the wheels turn, is the point at which the wheels *b*, touch the rail or road; and the difference in the arrangements figs. 4 and 5, is, that the power in fig. 4 is applied by the rope between the fulcrum *f*, and the centre *g*, of the wheels or pulley *a*, *b*, where the weight to be drawn is attached; whilst in fig. 5, the fulcrum is between the centre of the pulley and wheels *a*, *b*; consequently, the arrangements differ in the order of leverage, and in this instance the velocity will be as six to one.

In these two last arrangements, the rope *c*, *d*, may be either an endless rope, as described in figs. 1 and 2, or the rope may be single, and taking a turn around the pulley *a*, or *b*, is to be wound on and off a drum at each end of the distance, which is to be run by one length of rope.

The application of the improvements to the propelling of vessels in inland navigation, is an arrangement similar to that shown and described in figs. 2 and 3. A, representing a canal barge or boat, having an upright standard B, affixed on one side thereof, see figs. 6 and 7; at the top of this standard, the bearings c, c, are formed to receive the projecting arm D: in other respects the parts are similar to fig. 2, and the same letters are used to denote the various parts.

At proper intervals sheaves are placed on standards at the side of the canal or river, to support the rope *c*, *d*, as shown in these figures. In propelling vessels, the same description given of figs. 1 and 2, applies, and is fully descriptive of the effect which takes place by the application of the improvements.

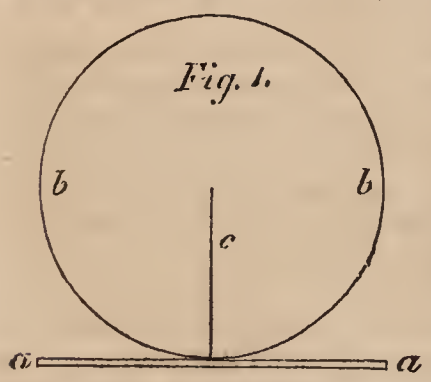
The power to be employed for causing the rope *c*, *d*, to be moved, may be varied according to circumstances. Thus, for instance, by attaching a horse or horses, according to the power required, to the rope *c*, *d*, and causing it to move slowly, a very considerable velocity will be obtained to the carriage or to the barge or vessel; or the

power may be derived from a fixed steam-engine, or water-wheel, or manual labour. And, in order to have perfect control over the carriage or vessel, and be able to stop at any time, although the rope is continuing to move, it will be necessary to separate the two pulleys *a*, *b*, by withdrawing the pin or bolt *q*; the power will then no longer act to propel the carriage or vessel, and, consequently, there will only be the momentum already obtained, by the carriage or vessel, to be overcome, and this in a carriage may be effected by aid of a brake on any of the carriage-wheels *k*.

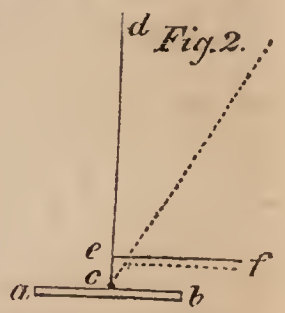
The interest excited by this improvement among mechanicians has induced Mr. J. S. Hawkins to submit to the Society of Civil Engineers, the following explanation of Mr. Saxton's pulley, premising the principle (what is familiar with every engineer and mechanician) that any radius of a wheel or pulley may be considered as a simple lever.

This investigation may be pursued under three cases.

Case the 1st.—Let the lower perpendicular radius of a vertical wheel of forty inches diameter, resting on a horizontal plane, be considered as a lever twenty inches long, see fig. 1, where *a*, represents the horizontal plane; *b*, the wheel; *c*, the lower radius or lever.

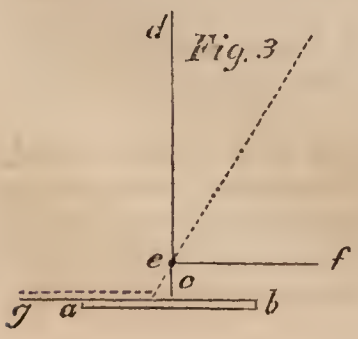


Let the lowest end of the radius where it meets the plane, be the fulcrum of the lever, and let a thread be fastened to the lever at two inches above the fucrum, as shown in fig. 2, where *a*, *b*, is the plane; *c*, *d*, the lever; *c*, the fulcrum; *e*, *f*, the thread. If that thread be pulled horizontally the distance of one inch, it is obvious, that the top of the lever will be moved in the same direction the distance of ten inches, as shown by the dotted lines.



Now let the top of the lever represent the axis of a wheel or pulley of twenty inches radius, and the pulley itself in rotation on the plane be considered as a continued succession of such simple levers, with fulcra progressing at the same rate, it will be evident that if a thread be fastened to, and wound around a pulley of eighteen inches radius, then the common axis will move forward ten inches for every inch motion of the thread; and the progressing fulcra, forming the periphery of the wheel, will keep pace with, and remain perpendicularly under the axis, the velocity of which to the speed of the thread, being as the radius of the wheel is to the difference of the two radii; in this case ten to one.

Case 2nd.—Let the thread mentioned in case 1st, be held fast so as to constitute it a fulcrum of the lever at two inches above the plane; and let another thread *c*, *g*, fig 3, be fastened to the bottom end of the lever, and pulled in an opposite direction, the distance of one inch, the result will be, that the top of the lever will be moved in a direction opposite the pull, the distance of nine inches, because the leverage will, in this case, be as nine to one; the dotted lines show the position to which it would be pulled.



Case 3rd.—Let both threads be pulled in opposite directions at the same time, and each drawn the distance of half an inch, then the top of the lever will be moved in the direction of the upper thread, the distance of nineteen half inches, or nine and a half inches, being as the sum of the two radii to their difference; and the common fulcrum will be at a point equidistant, and in a right line between the points of traction of the two threads, see fig. 4.

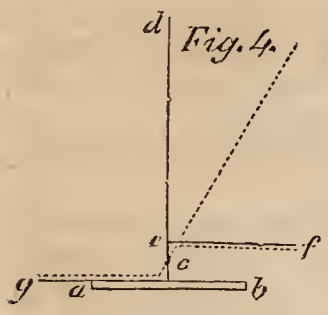


Fig. 4.

Now let the threads be fastened to, and pass around the peripheries of two concentric pulleys united together, of eighteen and twenty inches radii respectively, the threads being pulled in opposite directions, will cause the common axis of the pulleys to proceed in the same direction as the pull of the upper string, with a velocity of nineteen times the speed of the threads; being like the simple levers before shown, as the sum of the two radii is to their difference.

But, if instead of the two threads being fastened to the pulleys, an endless thread be made to pass around two riggers at the ends of the path of the pulleys, one side of which endless thread takes a single turn around one of the pulleys, and the other side of the thread a single turn around the other pulley, the endless thread being turned by one of the riggers, or by a power applied in any other manner, will draw the pulleys with the same proportional velocity, in the direction of the thread passing around the smaller pulley; see fig. 5, where *a*, is the endless thread; *b*, the riggers; *c*, the pulleys; *d*, the lower radius; *e*, the continuing place of the fulcrum of the leverage.

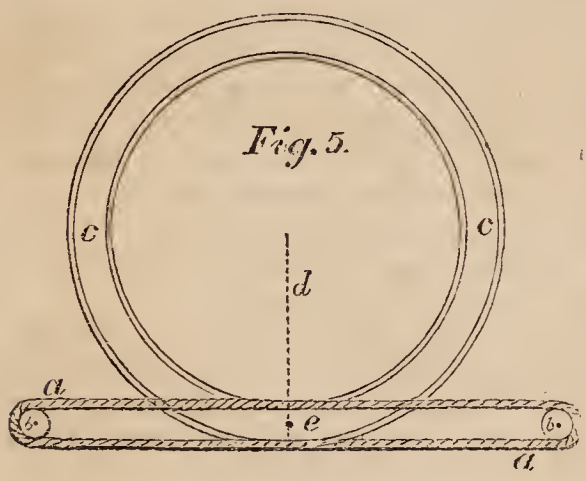


Fig. 5.

A model of Mr. Saxton's invention has been exhibited at the Gallery in Adelaide-street, West Strand, in which the pulleys are about as eight to nine, consequently, the sum seventeen to the difference one, expresses the real velocity of the carriage relative to that of the drawing cord; and a horse at his most effective speed of two and a half miles per hour, attached to an endless rope passing around pulleys in those proportions, would draw a carriage attached to the common axis at the rate of forty-two and a half miles per hour.

An experimental railway has also been constructed by subscription, at Park-street, Camden Town.

RAILWAYS.

Joint Stock Companies have been formed for the construction of railways from London to various important towns in the kingdom; but the only works actually in progress are, we believe, those of the railway to *Birmingham*.

From London the road will pass north of the Regent's Park, and

through, or near to, the towns of Pinner, Watford, Hemel-Hempstead, Berkhampstead, Leighton-Buzzard, Fenny-Stratford, Blisworth, Rugby, Coventry, and Stowbridge to Birmingham. Harrow, Rickmansworth, Tring, Woburn, Stony-Stratford, Newport-Pagnel, Towcester, Northampton, Daventry, Lutterworth, Kenilworth, Coleshill, and Solihull, will be all, at and within five miles of the line of the railway, and at and within ten miles of it lie the towns of St. Alban's, Dunstable, Wendover, Aylesbury, Buckingham, Olney, Leamington, Warwick, and Nuneaton. The highest elevations the road will have to reach are Tring, Kilsby, and Berkswell summits; it will pass through ten tunnels, and cross the rivers Colne, Ouse, and Avon.

The estimated cost of the work, after allowing for contingencies, is 2,500,000*l.*, including the purchase of land, and of engines, wagons, and coaches. The rate of travelling on the railway for coaches will be twenty miles per hour, and in the journey from London to Birmingham there will be a saving in time between the present mail-coach and the railway carriage of nearly six and a half hours—the former taking twelve hours to perform the distance that the latter will do in five hours thirty-eight minutes. Messrs. G. Stephenson and Son are the engineers.

Greenwich.—A joint stock company has been formed, and is now incorporated by Act of Parliament for this railway.

The line proposed for the railway is near that of the Deptford Lower Road; it will commence near the south end of London Bridge, and go in almost a straight line to Deptford, in passing through which town it will bend a little to the left, and fall into Greenwich at or near Thornton Row. The railway will be on an arched viaduct, so that no existing communications may be either intercepted or even interrupted by it.

The length of the railroad will be three miles and a half, and it is computed that the carriages will go the whole distance on it in twelve minutes. Mr. G. Landmann is the engineer of this work.

The Great Western Railway is projected from London to Bristol. A company has been established, and application is about to be made to Parliament for its incorporation, and Messrs. Brunel and Townsend are employed in the preliminary surveys. The railway will be from 115 to 120 miles in length, and is estimated to cost 2,805,320*l.* It will run through Bath, after quitting which it will pass near Chippenham, Wootton-Basset, Swindon, Wantage. Abingdon, Pangbourn, and Reading, and terminate probably at Paddington. Mr. Britton, in a lecture* on the benefits of this railroad, says, "by this the cargo of a vessel discharged in Bristol, may, in six hours, be in the centre of London; and Bristol may become, under these views, the great western port of London, being but six hours' distance from her."

Windsor.—A company has been formed for this railroad, but we are not aware that any further progress has been made.

Brighton.—A company has been formed, and two lines of road surveyed, both which are, it is believed, abandoned for the present.

Meanwhile, the Liverpool and Manchester Railway, the parent of these magnificent improvements, is flourishing. At the recent winter half-yearly general meeting, the directors reported that the receipts for the last year amounted to 97,234*l.*, and the disbursements to 56,350*l.*; leaving a profit of 40,884*l.*, and a dividend of 4*l.* 10*s.* per share for the last half year.*

* Read before the Literary and Philosophical Society of Bristol, October 19, 1833.

NEW COMPENSATING PENDULUM.

After the pendulum was applied as a regulator to clocks, and the other parts of these instruments had been rendered perfect in their construction, so great a regularity was obtained that the variations caused by the expansion and contraction of the rod of the pendulum, became sensible. M. Henry Robert, clock-maker at the Palais Royal, and pupil of Breguet, has lately communicated to the Society for the encouragement of National Industry, a more simple method than that in use for obtaining an exact compensation in pendulums beating the half second. The common method of compensation is to make the rod of the half-second pendulum of a single plantinum tube, and the bob of zinc; the difference in the expansions of these two metals is such, that by exact calculations a perfect correction is obtained. He then directed his attention to the pendulum with a wooden rod, for the purpose of using it in ornamental time-pieces, for which the zinc and platinum pendulum (gridiron) was unsuited, from the comparative plainness of its appearance. By a simple and easy device he has so constructed it as to protect it completely from the action of the atmosphere, so that it may now be substituted for the best metalic compensators, in every kind of clock.

In the construction of this new pendulum, M. R. profiting, on the one hand, by the well known property possessed by the wood of the fir tree, of preserving its length unaltered in all changes of temperature, has been enabled to confine his attention simply to its tendency to warp, by the absorption of moisture from the atmosphere, and to prevent this incloses the rod made of this wood in a metal box; the expansion of the bob corrects that of the tube.

This simple pendulum unites all the requisities of a good compensator, while at the same time it may be put together with ease; it takes up little room, is of a very simple form, and may be placed in the most beautiful models where the pendulum is exposed to view.*

BLASTING ROCKS UNDER WATER BY MEANS OF THE DIVING-BELL.

Three men are employed in the diving-bell; one holds the jumper, or boring-iron, which he keeps constantly turning; the other two strike alternately quick, smart strokes with hammers. When the hole is bored of the requisite depth, a tin cartridge, filled with gunpowder, about two inches in diameter, and a foot in length, is inserted, and sand placed above it. To the top of the cartridge a tin pipe is soldered, having a brass screw at the upper end. The diving-bell is then raised up slowly, and addi-

* Journal de l'Academie des Sciences.

tional tin pipes with brass screws are attached, until the pipes are about two feet above the surface of the water. The man who is to fire the charge is placed in a boat close to the tube, to the top of which a piece of cord is attached, which he holds in his left hand. Having in the boat a brazier with small pieces of iron red hot, he drops one of them down the tube, this immediately ignites the powder, and blows up the rock. A small part of the tube next the cartridge is destroyed; but the greater part, which is held by the cord, is reserved for future service. The workmen in the boat experience no shock; the only effect is a violent ebullition of the water, arising from the explosion; but those who stand on the shore, and upon any part of the rock connected with those blowing up, feel a very strong concussion. The only difference between the mode of blasting rock at Howth and at Plymouth is, that at the latter place they connect the tin pipes by a cement of white lead. A certain depth of water is necessary for safety, which should not be less than from eight to ten feet.*

SIGNAL LANTERNS.

Captain N. De Coninck, of the Royal Danish Navy, has invented a lantern to be used for signals, that is said to give a much more brilliant light than those at present employed for that purpose. The light is obtained on the argand principle, without the use of glass, by conveying a current of air through the lantern. The lamp will contain sufficient oil to last several hours, and is perfectly secured, by the construction of the lantern, from the effects of bad weather. We hear that they have been tried, with complete success, in a gale of wind. In addition to the brilliant light obtained from the application of the argand-burner, Captain Coninck has applied a circular reflector, which considerably increases the light.

The above officer has also applied the same principle to the construction of deck-lanterns, eight or ten of which, when placed amidships, are sufficient to give light to the guns on the deck of the largest man-of-war. The light is so well secured from external effects, that it withstands the concussion produced by the firing of the guns, which so frequently extinguishes the light in the common lantern. The efficacy of his lanterns has undergone a severe trial on board two Danish frigates. For this purpose, the lantern was suspended from the muzzle of the gun, which was fired with the lantern in that position. A common lantern placed by the gun was immediately extinguished by the concussion of the first discharge, while the new lantern remained steady during fourteen successive discharges, when it was extinguished by the united effects of the concussion and the great vibratory motion it obtained.†

* Repertory of Arts. † Nautical Magazine.

BISCUIT-BAKING MACHINERY.

Mr. T. T. Grant, store-keeper of the Royal Clarence Victualling Establishment, at Weevil, near Portsmouth, has invented this ingenious biscuit-baking machinery at the above establishment; which he thus circumstantially describes in the *United Service Journal*:—"The first operation in this biscuit-baking operation consists, you may suppose, in mixing the flour and water together; but I should tell you that, antecedent to that, the establishment has ground the flour in mills, worked by the same machine which gives motion to those parts I am about to describe. Nor is this an immaterial point; for by it all possibility of mixing improper ingredients along with the flour is prevented, and precisely that proportion of the bran which is required in the composition of good biscuit is retained. I ought likewise to have mentioned before, that adjacent to the mills stand a series of four granaries, each capable of holding fifteen hundred quarters,—in all, six thousand quarters. The flour mill is furnished with ten pairs of stones, by which forty bushels of flour can be ground and dressed, ready for baking, in an hour. The baking establishment consists of nine ovens, each thirteen feet by eleven, and seventeen inches and a half in height. These are heated by furnaces attached to each, so constructed that a blast of hot air and fire sweeps through them, and gives to the interior the adequate dose of heat in an incredibly short time.

The commencement of the baking consists in introducing into a trough thirteen gallons and a half of water, and then allowing to enter it a sack of what is technically called biscuit meal flour. weighing 280 pounds. When the whole has been poured in by a channel communicable with an upper room, a bell rings and the trough is closed. A singular apparatus, consisting of two sets of what are called knives, each ten in number, are made to revolve amongst the flour and water, by means of the machinery. This mixing lasts one minute and a half, during which time the double set of knives, or stirrers, make twenty-six evolutions. Each batch of the dough thus rudely mixed weighs 388 pounds, and forms eventually two suits and a half of bread, weighing 250 pounds, or in other words, 1,250 biscuits, each suit or batch being 100 pounds in weight. The next process is to cast the lumps of dough under what are called breaking rollers, huge cylinders of iron, weighing 14 cwt, each, and moved horizontally by the machinery along stout tables. The dough is thus formed into large, rude masses, six feet long by three broad, and several inches thick. At this stage of the business, the kneading is still very imperfect, and some traces of dry flour may still be detected. These great masses of dough are now drawn out, and cut into a number of smaller portions, about a foot and a half long by a foot wide, and again thrust under the rollers. I forget how many times the dough is made to pass under these rollers, but sufficiently often to make the mixture so complete that the slightest

trace of inequality is not to be discovered in any part of its substance. I should mention that two workmen stand, one at each side of each roller, and as the dough is flattened out they fold it up, or double one part upon another, so that the roller at its next passage squeezes these parts together, and forces the parts to mix. After this process has been gone through a sufficient length of time, the dough is cut into small portions, and being placed on large, flat boards, is transported by the sole agency of the machinery, in the most comical manner, from the centre to the extremity of the baking room. Here it is received by a workman, who soon places it under what is called the sheet roller, but it would be better named the blanket roller, for in size and thickness, and nearly in colour, it resembles a blanket. The kneading is thus rendered quite complete, and the dough is in a fit state for the oven, and it only requires to be cut into biscuits. This part of the proceeding is admirably contrived. It is effected by what is called a cutting plate, consisting of a net work of fifty-two sharp-edged, hexagonal frames, each as large as a biscuit. This frame is moved slowly up and down by the machinery, and the workman, watching his opportunity, slides under it the above-described blanket of dough, which is about the size of the leaf of a dining table, and in the next minute down comes the cutting-frame, indents the sheet, but does not actually cut it through; for enough of the substance is left uncut to enable the workman at the mouth of the oven to jerk the whole mass of fifty-two biscuits unbroken into the oven. It may be asked, how it happens that the dough does not stick to the frame? But this is prevented by a most ingenious device. Besides the cutting portion of each of the two hexagons, there is a small, flat, open frame, movable up and down, carrying above it a ball of iron several ounces in weight. When the great frame comes down upon the dough, and cuts out the fifty-two biscuits, each of these minor frames yields to the pressure, and all the little iron balls are seen to rise up; but as soon as the great frame rises, the weight of the balls, acting on the little frames over each biscuit, thrusts the whole blanket off, and allows the workman to pull it out. One quarter of an hour is sufficient to bake the biscuit, which is afterwards placed for three days in a drying room, heated to 85° or 90°, which completes the process.

The whole nine ovens bake about a ton of bread an hour, or ten thousand biscuits. If, instead of nine, there were twelve ovens, it has been calculated that 70,000 cwt. of bread might be baked in a year. Now, it appears that the average quantity issued from Deptford, Portsmouth, and Plymouth, during the last five years, was 68,000 cwt.; consequently, if this branch of the Royal Clarence Victualling Establishment were increased by only three ovens (and no further machinery), all the biscuit required by the navy might be prepared by the admirable process on one spot. The relative cost of making the above quantity of

bread by hand, or by the machinery actually erected and in operation, I have taken some pains to ascertain :—

Cost, by Machinery	1,560
Ditto, by Hand	5,260
Saving in the wages of labour	£3,700

From this saving there must, of course, be deducted a portion of the interest of the money laid out in the machinery. I say a portion of the interest, because the same steam engine which moves the baking apparatus turns ten pairs of mill stones, and pumps up water for the supply of his Majesty's ships, and it is only a small part of the power, which must be kept in action at any rate, that is directed to these baking purposes. When, however, the large engine is not required to grind flour, or to pump up water, a small ten horse engine is set in motion, if it be required, to bake bread.

The foregoing calculation of what twelve ovens could perform is an estimate. The following statement is derived from actual experiment :—

In 116 days, during 68 of which the work was continued for 7½ hours, and 48 for 5¾ hours only, in all 769 actual working hours, equal to 77 days, at ten hours each day, the following quantity of bread was baked in nine ovens, at the Royal Clarence establishment—12,307 cwt. of biscuit, which is equal to 1,378,400 pounds.

The wages of the men employed in baking this quantity of bread amounted to	273	10	9½
If it had been made by hand, the wages of the men employed would have been	933	5	10
Saving in the wages of labour	£659	7	0½

In this, I may repeat, is not included any part of the interest of the sum laid out on the machine, or spent in keeping it in order. But in a very few years, at such an immense rate of saving, the cost of the engine and other machinery would be repaid.

The machinery bread, though at first objected to by many persons, has become universally popular in the navy. It is better, decidedly, than any which has heretofore been supplied to his Majesty's ships, and it promises to keep better. Formerly the sailors very rarely, if ever, took up the whole of their allowance of bread; but since the machinery biscuit has been issued, it seldom occurs that a single pound is left behind. If the intention of stowing it in iron tanks be followed up, the fresh quality may be preserved for any length of time, and the "remainder biscuit," after a voyage, cease to be a proverb redolent of weavils, mouldiness, and dust.

STEAM BRIDGE.

A FLOATING bridge, worked by steam, has recently been opened at Saltash Ferry, Cornwall. The float forms a parallelogram of

about fifty feet by thirty feet, open at both ends; the centre is occupied by two engines of six-horse power each, boxed over from end to end, so as to be entirely concealed externally; the engines work two wheels, on which rest two chains, which are laid from shore to shore, and traverse through the engine-room. On either side the engine-room is a clear space of fifty feet by ten, for carriages, horses, cattle, and foot-passengers. The prows or platforms for shipping and landing are four in number: they drop on the shore, and form almost a level platform. The whole was invented and executed by Mr. Rendell, the engineer, who constructed the floating bridge at Dartmouth.*

LORD STANHOPE'S COMPOSITION FOR ROOFS.

THE architects (Wyatville, Soane, Smirke, and Seward,) who were some time ago appointed by the Lords of the Treasury to inquire into the state of the new palace built on the site of Buckingham House, made a report with respect to the roof in the following terms:—

"The principal part of the roof of the palace is covered with a composition, commonly known by the name of Lord Stanhope's; and we cannot omit to express the strong doubts we entertain of the permanent security which it can afford against the effects of the weather. Upon a careful inspection of the state of the composition, we observe that it is at this time cracked in many places, upon different parts of the roof covered with it; and in the fissures of these cracks the wet remains until it is evaporated, or, what is more probable, absorbed in the brickwork under it. As it has been laid upon arches of bricks, formed between the iron bearers over the ceilings of the upper rooms, where there are two tier of these arches, one raised a little above the other, a considerable time may elapse before the rains have penetrated to the ceilings; but the wet has already penetrated through the covering of one room (the south-west tower), where there is only one tier of these arches. We are informed that means may be readily taken for closing these fissures; but as there can be no security against the recurrence of the mischief, from the same cause which has now produced it, and as the cracks are discovered only by a careful examination and the removal of the slates which are laid upon the surface of the composition, we are of opinion that it will be found necessary to remove it altogether, and substitute a covering of a more durable and effectual nature."

Mr. Nash, the architect of the palace, in answer to these objections, showed satisfactorily that they arose from the surveying architects not being sufficiently acquainted with the nature of the composition in question, and the manner of applying it; with respect to which he furnished the following very curious and instructive particulars:—

* Hants Advertiser.

"I have reason to believe that not one of those gentlemen has ever had experience in the use of Lord Stanhope's composition * *. If they had taken the trouble to inform themselves of the nature and qualities of the composition, they would have learned that the upper coat, in which they saw fissures, has not the slightest effect on the roof; that it is, from its nature and hardness, always full of cracks; and that though the fissures (as they invidiously call them) should be full of water, it could not penetrate the roof unless the first coat were to crack also; but the first coat, from its property, which is to dilate and contract with the weather, never can crack, and the water never can get into the fissures of the upper coat so long as the slates above remain perfect. That these slates are most durable will be evident, when the Committee learn that they are not laid on the surface, as invidiously described, but bedded in the upper coat whilst in a boiling state, insomuch that it is scarcely possible to break a slate so bedded. I have had experiments made at the palace, in the presence of an eminent architect, to ascertain the fact; and at Killymoon, in Ireland, whilst that castellated house was building, a large stone corbel, of more than a hundred weight, fell from a lofty tower on the flat beneath; the corbel, which was of hard stone, broke into several pieces, whilst the flat remained uninjured. This composition consists of three coats; namely, the first coat, composed of tar and chalk only, and which always remains elastic; the second coat is composed of the same materials, with the addition of coarse sand to harden it, in order to make a firm bed for the slates (and it is this sand which causes the cracks whilst the material is cooling); the third coat is the slates, which are bedded on the second coat whilst boiling hot, and effectually prevent any wet penetrating to the second coat, of which the slates (being bedded into it whilst in a boiling state) are an integral part, and from which they can only be separated with difficulty, and are immovable by any other cause than force purposely applied to raise them, which has been done by the architects to many parts of the roof of the palace, very much to its injury. The covering is laid upon brick arches. That the *surmises* of the architects, that the water is making its way through these cement arches are most groundless, could easily have been ascertained by an examination of them. This is the most economical covering for roofs that can be adopted; and I know of none (not even lead or copper) that have such properties. Not one of the fissures, so called, has hitherto admitted any wet to pass through; nor could any water get into these fissures whilst the slates are bedded on them. The cess-pool, at the angle of the small, independent, south-west tower, is the only place where they find a failure; and that is an evil to which every roof is liable where there is a cess-pool. Such is the nature of the composition, that any workman, with a hot iron, can, in a few minutes, and at a trifling expense, repair any defective place, should an accident occur. But to

these doubts and surmises of the architects, and to *their arguments founded on doubts*, I will oppose facts. I have used this composition for thirty-five years on a very large scale, and never have known it fail. The buildings covered during that period are now as sound as when first done. Indeed, all the houses I have ever built, which have flat roofs, are covered with it. Many years ago Lord Palmerston took off a lead flat at his house in Hanover Square, which was constantly leaking, and covered it with Lord Stanhope's composition. I am told it has never leaked since. Very many houses in Ireland I have covered with it; and at the Pavilion at Brighton, where the work has been done twelve years, and the composition is laid upon timber (much more likely to skrink than the iron and brick work at the palace), the water has never penetrated. The house in which I am now living has been done for seven years, with *one coat only* (without the upper coat and slates), and stands well. These incontrovertible facts I beg to oppose to the fears and conjectures expressed by the architects, and unhesitatingly to state my belief, that, if any composition is imperishable, it is that with which the palace is covered. I know not how the architects can recommend the substitution of a material of a "more durable and effectual nature," when they acknowledge that this has *not yet failed*, and that they only apprehend it *may fail;* and when they say also, that the cracks are discovered only by a careful examination, and the removal of the slates which are laid upon the surface of the composition, I am confident that if, instead of following the advice dictated by their fears, it be left till some defect really shall appear, a very few years (it has now stood four years) will show the fallacy of their arguments, the groundlessness of *their apprehensions*, and the impropriety of delivering an injurious opinion founded on ignorant fears."*

PRESERVATION OF WOOD.

A METHOD of preserving building timber from decay has long been a desideratum. The attempts hitherto made, have not, however, been attended with success. Timber for ship building is subject to a peculiar species of decay, called the *dry rot*, a method of preventing which would be exceedingly valuable. At the meeting of the Society for the encouragement of National Industry on the 21st of December, 1831, M. Bréant, Assayer of the Mint, and an able chemist, exhibited several pieces of wood of many inches square, and several feet long, which had been prepared by him according to a new process, which is expected to preserve them from every species of decay. The details of the method have not been made public by M. B.; he has merely stated that the wood is soaked in saline solutions and in oily and resinous

* Quoted in the Mechanics' Magazine.

matters. These substances penetrate so completely throughout the mass of the wood, that when one of the blocks exhibited before the society was sawed in half in presence of the members, it was found to be thoroughly impregnated with them even to its very centre. M. B's process requires but two or three days for completion, even in blocks of wood of a large size. If farther experience confirm what science has thus suggested, the difficult problem of the preservation of wood may be considered as solved. M. B. states that he will shortly be able to furnish timber of all sizes prepared in this way.*

NEW BOAT FOR CANALS.

TRIALS have been made upon the Paddington Canal of a new canal boat; the object of which was to show, that a boat built in a different form, and constructed of other materials than those of the ordinary canal boat, might, by using superior horses, be drawn along the water at the rate of ten miles or more in an hour, instead of at two, the pace of the boats now in use. The day was remarkably fine. The portion of the canal more particularly appropriated to the experiment was from the third to the seventh mile from Paddington. The boat was constructed of sheet iron, riveted hot. It was 70 feet long, by five and a half wide, painted green and white, and provided with an awning of white twilled cotton cloth, rendered semi-transparent with oil. The rudder is a single sheet of iron about a yard long, and moved by a tiller made of about two yards of stout rod iron. Two steady hunting horses, each mounted by a lad, and the two harnessed to a towing rope of about 150 feet in length, constituted the moving power. The number of persons on board the boat was 48, including the crew, the gentlemen making the experiment, some of the principal members of the Grand Junction Company, and the visiters, amongst whom were Mr. Telford, Mr. Babbage, and Captain Basil Hall. Certain distances were measured on the canal bank, and marks set up at the ends of them. At each of these places also, a man was stationed with a gauged rod in his hand, with which, as the boat passed, he might mark the height of the wave caused by the disturbance of the water. The speed from one station to another, taken by second watches, showed, for some time, a progress at the rate of thirteen miles an hour. The horses, however began to tire, and the speed fell to eleven, and ultimately, in returning for the third time, to ten and a quarter. The motion is the easiest imaginable. The boat glides along the water so smoothly and noiselessly, that its progress is all but imperceptible to those on board whose attention is not directed to external objects. The banks of the canal will have to be edged for nine or ten inches above the ordinary level of the water with

* Journal de l'Academie des Sciences.

hard materials, and the towing path to be slightly sloped outwards.*

RANGER'S PATENT CEMENT OR COMPOSITION.

THE specification states, "My cement or composition is intended to form blocks or masses of artificial stone, to be used in the construction of buildings, in place of brick or stone, or in union with either, or both of them, as occasion may require; and I compose it of siliceous or other fit and proper, hard and unchangeable, matters; of powdered lime in its pure or caustic state; and of water boiled or heated; and which said water I employ as hot as conveniently may be, in mixing the different ingredients. I likewise occasionally dissolve a portion, more or less, of sulphate of iron in this water, as well also as caseous and other matters, when thought desirable. I prefer to use such stone lime as contains a portion of iron; such, for instance, as that procured in the neighbourhood of Dorking or Reigate, in the county of Surrey; also gray-stone lime, lime from blue or yellow lias, or any other lime which is fit and proper for the purpose: and I employ it in the state of a dry powder, not slaked, as usual. The siliceous or other hard materials or matters may be such as are commonly employed; for instance, river or sea sand; skreened shingle from the sea-shore or beach; the two latter, however, well washed in fresh water to free them from sea-salt; or I can employ broken flints, free-stone, copper-slag, or other fit and proper materials of similar natures. Any, or either of these substances, as well as the lime, I separate or reduce into finer or coarser parts, either by hand, or by the employment of machinery similar to that used in making Roman cement, or any other which is fit and proper for the purpose, agreeably to the nature of the artificial stone I design to employ them to form. In general, I prefer to use them in the following proportions, videlicet,—siliceous or other hard materials or matters, thirty pounds; powdered lime, three pounds; and boiling or hot water, either containing or not the above matters in solution, one pound twelve ounces. I can, however, vary these proportions occasionally, although I have hitherto found them the best in practice. I avoid mixing more of these materials at once than will be sufficient to fill the mould, as, owing to the heat produced by the boiling or heated water, the setting or concreting action begins to commence instantly they are put into the mould; and in general, the mass of artificial stone becomes sufficiently firm in the course of about ten minutes, to admit of the sides and ends of the mould being removed, and the block left upon the bottom of it ready to be taken to the place where it is to remain to dry and harden, and which will usually happen in the course of a fortnight, when the block or mass will

* Hants Telegraph.

be fit for use. I cause the materials to be carefully rammed close in all their parts whilst filling the mould with them, in order to expel the air; and remove any excess thereof by passing a straight iron bar or scraper along the top of the mould; I can then, likewise, when thought desirable, fill any interstices or cavities left in the face of the block, with materials of a finer consistency. The moulds will, of course, vary in their forms and manner of framing them, according to the shapes intended to be given to the masses or blocks of artificial stone; as, for instance, whether they are to be plain, or moulded in flutings, or otherwise ornamented or decorated; or whether to be square, circular, or of any other shapes; so that it is quite impossible to afford examples thereof to any extent.

"I do not mean, or intend hereby, to claim as my invention, the use of hot water in mixing mortar for building with; but I do hereby claim the employment of boiling or hot water in combination with dry powdered caustic lime, and siliceous or other hard matters, in the manner and in the proportions hereinbefore described, as my invention, and as essential to the forming of my said blocks or masses of artificial stone."*

STEAM-BOAT PADDLES.

A VERY ingenious substitute for the present paddles of steamboats has been made by Mr. T. Grant, the inventer of the machinery in the victualling department at Weovil. Our readers are aware of the disadvantages which necessarily belong to the paddle now in use, and also that several attempts have been made, but hitherto in vain, to obviate them. The principal objection to them, is in the motion of the paddle after it passes the vertical position, the force of the engine being then absolutely employed in lifting the water, whereby it is not only lost in propelling the vessel, but also operates much to her disadvantage. In fact, it is quite evident that the tendency of the paddle in its revolution, before it reaches the vertical position, is to raise the vessel, and after it has passed it, to depress her in the water; although the effect of the former, from the rapidity of the vessel's motion, may be considered trifling in comparison with the latter. Mr. Grant is of opinion that his invention will do away with this difficulty, inasmuch as his paddles always preserve the vertical position, which only is the proper one for the paddle to act with its full effect. His invention is exceedingly simple and ingenious. It may be described as follows:—About five feet above the water-line of the vessel, two three-throw crank shafts project horizontally, which are driven by a centre, and two spur wheels. The paddles are suspended from the foremost crank shaft, one from each crank, and are kept in the vertical position during the

* Repertory of Arts.

revolution by being attached to rods, which connect them with the after crank shaft, and they thus work simultaneously, each paddle describing a semicircle. There are several advantages attending these paddles, among which are the facility of unshipping them when not required, and the disposal of the huge and unsightly paddle-box belonging to steam-vessels, and so detrimental to men-of-war. The velocity may be varied in the new paddle as in the old paddle, by the number of revolutions in the minute; and in a vessel of 300 tons, Mr. Grant calculates that he keeps a surface of thirty square feet in motion.*

Captain F. R. Chesney, of the Royal Artillery, who has lately returned from an interesting journey on the Euphrates, has proposed a method of protecting the paddles of steam-vessels from external injury by shot or otherwise. In his descent of the Euphrates, the attention of Captain Chesney was directed to the navigation of that river by means of steam-vessels. The free passage of it is much molested by the Arabs, and is also rendered somewhat difficult in several parts, through channels which become narrow when the river is low; and in order to obviate these difficulties, and effectually to protect the paddles of a vessel from the shots of the Arabs, or concussion against the rocks, Captain Chesney proposes the following simple method:

He divides the vessel longitudinally, or in the direction of the keel, into three parts, between which he places his paddles; the engine, boiler, &c. of course being in the middle one. The two outer parts are secured to the principal or middle one by diagonal cross-beams on the upper deck, and by the shaft of the paddles below, leaving a space equal to their breadth between them for the free passage of the water fore and aft the vessel.

It is evident that such a vessel can only be made use of in smooth water, and that also by means of steam alone, where the propelling power is in the direction of the line of motion. A vessel so constructed gains stability, but is altogether, from a want of connexion throughout, unfit to resist the pressure of sails. Experience alone will prove how far the plan may succeed; we believe it to be entirely new; and, under the circumstances for which Captain Chesney has designed it, we see no particular reason why it should not answer his purpose. The length of the vessel on deck he proposes should be about fifty-two feet, and sixteen feet six inches beam, and considers that her draught of water would be eighteen or twenty inches. Experience again will set all this right; but in the mean time Captain Chesney's plans deserve every encouragement, on account of their ingenuity, and the importance of the subject which has suggested them, namely, a speedy communication with India. This method of

* Nautical Magazine.

securing the paddles was first designed by Captain Chesney in the summer of 1831.*

IMPROVEMENTS IN STEAM NAVIGATION.

THAT the science of naval warfare, by the introduction of steam vessels, will undergo a complete change, no one in the least degree conversant with the advantages arising from the extraordinary power of the steam engine can reasonably doubt.

One of the first objects of the present administration has been the adoption of these vessels in the Royal Navy, and the efficiency of the measure is proved beyond the chances of probability. Although they have been employed in private speculations on our coast for some years, a grant from parliament for the improvement of steam navigation has only been obtained during the present administration. Steam navigation is, however, yet in its infancy, and various experiments have been undertaken, and are continually going forward, with a view to the improvement of the vessel as well as of the engine, paddle-wheels, &c. The great obstacle to the former, as well as to the improvement of our mercantile marine in general, is the existing condition of the tonnage laws. The English method of determining a vessel's tonnage is well known to be fraught with error, and the law is evaded by every artificial means. In order to do this, some builders have given double, or artificial sides, to their vessel ; but these, independent of the cost of material and labour, are highly prejudicial to their stability ; besides greatly circumscribing the internal dimensions of the vessel. And, if the liability to dry-rot in steam vessels be considered, which is produced from the various degrees of temperature occasioned by the heat of the boilers, bilge water impregnated with oil and tallow, at all times highly offensive, the system must be pronounced bad. Indeed all vessels built on this plan, that comes within our knowledge, from being affected with this disease, have cost the owners more than would have built a new vessel. About ten years ago, a steam-vessel of my own was built on this plan, with the view of circumscribing her dimensions within the least possible form, purely with the object of evading the tonnage laws. The result, was, that, in four years afterwards, the dry-rot had gained to such an alarming extent in her, as to render it absolutely necessary to give her repairs to the extent of £4,000.

With regard to Government steamers, the services of which are so widely different from those employed conveying passengers and goods, an alteration on the present system of employing the propelling power appears advisable. All Government steamers intended as vessels of war, with a propelling power exceeding 140 horse power, should have three instead of two engines. That

* Nautical Magazine.

my reasons for recommending this measure may be clearly understood, it may be observed, that the material of an engine above 80 horse-power, such as piston-rods, side-rods, cylinder, lever, side-beams, gudgeons, &c. which are all liable to casualties, then become so ponderous and unwieldy, that, in the event of accidents, even supposing duplicates to be on board, much time will necessarily be lost before the least damage can be repaired. And we might even go further, in supposing, no uncommon thing in sea-going vessels, that one engine be altogether disabled. When such an accident happens in a vessel having only two engines, she is rendered almost usless: but were the same thing to take place in a steamer having three engines, the loss of the third would scarcely be felt. During war, all our coasting convoys will unquestionably be conducted by steam, and these vessels will be employed blockading the enemy's ports, and attending on fleets. Now, when employed on such services, it is very evident that the whole power of the steam will seldom be required; consequently two engines will do more work than probably will be wanted. A steam-vessel running before a gale, and a high sea, requires no ordinary care and attention in the management of the engines; and under such circumstances, probably one-third of the steam generated is quite sufficient to drive them, for, were more at the time admitted into the cylinders, the risk of dashing the engines into a thousand pieces would be incured. The economy of fuel also, as being an object in steamers of the first consideration, ought always to be borne in mind, and at all times strongly impressed on the attention of officers in command, for without this article the vessel becomes worse than useless.

A steam-vessel having three engines on board, and eight fire-places, or furnaces, in her boilers, could, under the above mentioned circumstances, easily extinguish two fires, and uncouple one engine; by doing which the saving of fuel would be immense. A steamer having only two engines can never do this. It may be objected, that the space occupied by three engines would be so great as to render the adoption of this suggestion unavailable; but we are quite prepared to maintain, that three engines of 70 horse-power each will stand in a much less space than two engines of 100 horse-power each can do.

The power of driving one wheel forward and the other backward at the same time, is the first among the desiderata in the management of steam-vessels.*

LAWS OF FRICTION.

NOTWITHSTANDING the ability of Coulomb, and the care which he bestowed upon all his experiments, his researches upon the subject of friction, the results of which are given in the memoirs

* Nautical Magazine.

of the French academy for 1785, were incomplete, and in some respects, contradictory, and their accuracy has been, in consequence, suspected. The researches since made upon the same subject by Rennie, Vince, and others, have neither been sufficiently extensive nor precise to set the question at rest. Mr. Morin, by means of an apparatus better calculated for giving precise results than that of Coulomb, has lately made a new set of experiments, varying the velocity from the lowest up to ten feet and upwards a second. The rubbing surfaces also varied from some tenths of a square inch to nearly five hundred square inches, and the pressures from ninety pounds to two thousand pounds, and were carried even as high as 2,500 lbs. All the experiments made within these limits, agree in showing that the friction of surfaces moving on each other, is independent both of the velocity and the surface, and proportional to the pressure. Coulomb, it is true, had already infered these laws, but he stated many exceptions to them, which, according to the present researches, do not exist. Coulomb supposed that in the case of oak moving over oak, the grain of the wood all running the same way, and in the direction of the motion, the relation of friction to pressure was 11 per cent., while Mr. Morin found it to be 48 and 32. Mr. Morin found for elm running over oak 48, when the fibres are parallel, and 41 when they are perpendicular. He also rectifies the mistake of mechanics who believe the friction to be less between heterogenous substances than between those of the same kind, and shows that the friction of metals on wood is greater than that of oak on oak; thus when iron is made to move over oak, the ratio is 61; and in the case of copper over the same wood, the ratio rises to 62. These interesting experiments, a report upon which is to to be made to the academy by Messrs. Poisson, Arago, and Navier, will be continued by the author, who intends to obtain, if it be possible, the coefficient of friction for all the materials employed in the mechanic arts in building, &c.*

THE CHIRAGON, OR GUIDE FOR THE HAND.

Mr. William Stidolph, a schoolmaster at Blackheath, has invented an apparatus, to which the name of chiragon is given; by the assistance of which, a person who has become blind after having learned the art of writing, may continue its practice without the risk of confounding words or lines together. It consists of a frame, with a raised margin, upon which margin is placed a narrow piece of wood, having a groove to receive a corresponding key that is attached to a collar or bracelet for the wrist. In the sides of the frame, a series of notches are cut, into which the grooved piece of wood is placed, successively, so as to form the

* Journal de l'Academie des Sciences.

regular intervals between the lines, whilst the hand is permitted by the collar to pass freely from left to right, but, is confined to certain limits in its action up and down, or in the direction of the paper used. The writing is effected with Mordan's patent pencils; and we have proved the efficiency of the invention, by writing a letter, with its guidance, while our eyes were bandaged so as to exclude the sight of every object.*

BLOWING MACHINES.

Mr. A. Clark, of Holywell, North Wales, has patented certain improvements in Blowing Machines. His invention consists of an arrangement of apparatus having a revolving fan, such as is used in many blowing machines now in use; and the chief object, at present, in view, appears to be, the production of a portable machine, to be used as a substitute for the common bellows. To the end of a nosle similar to those used for bellows, is affixed a shallow cylindrical box, which contains a circular disc, mounted on an axis which turns in bearings at each end, in the covers of the cylindrical box. On to the disc, and at the outer edge thereof, vanes are affixed at right angles, and at one end of the cylindrical box, an opening is cut for the admission of air; and on to the axis which carries the revolving fan, is a small wheel, which is kept, (by means of a spring), in contact with a large wheel which has its axis affixed on the nosle-piece.

The manner of using this machine is as follows:—It is held in the left-hand, and by means of a handle affixed on the large wheel this wheel is caused to revolve, and by the friction of its periphery the small wheel is made to revolve rapidly, and drive the air through the nosle. In order to prevent noise or rattling of the parts, the patentee recommends that the large or driving wheel should be covered with buff-leather.†

NEW ROLLERS FOR INKING LITHOGRAPHIC STONES.

The rollers used in lithography for inking the stones, consist generally of cylinders of wood covered with calf-skin, and stuffed with carded wool. Besides the inequalities which the surfaces of such rollers present, the seam uniting the two sides of the leather makes a ridge which spoils the uniformity of the inking, particularly when large stones are used. This has hitherto been a great obstacle in the progress of the lithographic art. This ridge had been reduced, and practice had taught a method of concealing, in part, the defects necessarily attendant upon the use of rollers with seams; but the inconvenience and many defects still remained to be remedied. M. Tudot, incited by an appeal of the Society for the Encouragement of National Industry, conceived

* Athenæum. † Repertory of Arts.

the idea of making rollers of round plates of different substances cut with a punch, then threaded together on a cylinder of wood, pressed forcibly one against the other, and polished or trimmed. He has tried in this way chamois leather, calico, and calf skin. This last material answered best, and furnished rollers which were soft, without seams, and which distributed the ink uniformly. M. de Lasteyrie, a competent judge in these matters, observes, that the ordinary (seamed) rollers are very quickly worn out, while those of M. T. will not be exposed to the operation of the same causes of wear and tear, and will, therefore, greatly outlast the others.

The new rollers are rather higher priced than the common ones, but it is confidently expected that their continued manufacture will admit of a reduction in the price. M. Tudot has received a prize of 500 francs for the ingenuity displayed in his invention.*

ON THE APPLICATION OF STEAM EXPANSIVELY IN CORNISH STEAM-ENGINES.

By E. Galloway, Esq., Civil Engineer.

The anxious attention which has been for some time devoted to the steam engine, with a view to its more efficient application to the propulsion of vessels, having induced an inquiry into the alleged superiority of the Cornish engines, I was solicited, in the early part of the last year, to ascertain by experiment, the nature of the improvements, and the amount of advantages assignable to each. I, therefore, devoted several weeks to a succession of experiments on various engines, all of which tended to confirm the accuracy of the printed reports, having, in every instance, found the performance to exceed considerably the amount stated therein.

It will not be necessary for me to describe the mode of estimating the duty of the engines in Cornwall, further than to state that the term "horse-power," which we use to express the power of a steam-engine, is never used in Cornwall. As these engines are principally employed in drawing water from the mines, it is the practice to express the duty of an engine by the number of lbs. it raises in a given time, to the height of one foot. This is ascertained by multiplying the weight lifted in a stated period, by the height in feet it is lifted. Thus, if we lift 1,000 lbs. of water 20 feet high per stroke, it would be equivalent to 20,000 lifted one foot high. The power of an engine, therefore, is expressed by the number of lbs. it can lift one foot high in a given time; and its expenditure of fuel, and consequent efficiency, by the number of lbs. it lifts to the height of one foot with one bushel of coals. The comparative merits of different engines, therefore (whatever be their power or depth of the mines), are easily ascertained by this simple process. Thus, if we describe

* Mémorial Encyclopédique.

an engine to lift 100 millions of pounds, one foot high per hour, we ascertain its power; but if we say it lifts 100 millions one foot high, whilst it consumes two bushels of coal, we ascertain the work done with one bushel of coal; and, by comparing that performance with that of another engine, during the consumption of the same quantity of fuel, we thereby ascertain the comparative efficiency of the two engines.

An experiment, made by Mr. Rennie at the instance of the Admiralty, having been tried a short time previous to my visit to Cornwall, I was induced to experiment on the same engine—Wilson's engine at Wheal Towan. The result was, that, during six hours and five minutes, the engine consumed ten bushels of coal, raising 125,749,330 lbs. one foot high with each bushel; whilst during Mr. Rennie's experiment, the same engine only raised 92,327,000 lbs. per bushel. To prevent scepticism regarding this extraordinary performance, I have to state, that as a check on the action of the pumps, I had cisterns fitted with sluices at the top of each lift; and, at various periods during the experiment, I ascertained, by shutting down the sluices, the quantity of water delivered into each cistern by a single stroke of the engine; so that, having previously ascertained the distance between each lift, and the capacity of the cisterns, an error was impossible. A very trifling difference of result was obtained by the two modes of calculation. The coals were weighed, and the stock of coals on the premises locked up during the experiment.

The best engines, by Bolton and Watt, are estimated as capable of raising 19,800,000 lbs. per bushel of coals. The Wheal Towan engine, therefore, during my experiment, performed upwards of six times the duty of Bolton and Watt's engines!

In my inquiry into the cause of this extraordinary, and almost incredible performance, I shall first point out every variation from the Bolton and Watt engine, and then estimate, as far as is practicable, the proportion of advantage belonging to each.

The variations are:—

1st. Cylindric boilers of considerable length. A large tube passing concentrically through them. Fire applied in the tube, and heated air made afterwards to circulate first under, and then along the sides of the boiler. The area of the side flues are generally as large as the area of the tube, and the passage is contracted by a damper being placed in the tunnel, from the boiler to the stack or chimney.

2nd. In the management of the fire itself. The fire is large and thick: the fire-doors open nearly to the full breath of the tube: the coals are spread or dusted over the surface of the fire—the fire is never stirred or stoked, except at the time of cleansing.

It is a singular fact, that those coals are prefered which, in a brisker fire, clinker most; none but Welsh coals have hitherto been used. The coal which is prefered is a mixture of various Welsh coals.

3rd. In using steam of 20 to 50 lbs. on the inch, and in expanding the steam, by cutting off the communication between the boiler and cylinder, at 1-4th or 1-5th of the stroke.

4th. In covering, or "clothing" the boiler, steam pipes, steam-chests, and cylinder, with a non-conducting substance, such as saw-dust or straw, where the heat of steam only can be the contact, and "cob," that is, clay and straw, over the brick-work of the fire.

5th. In suspending the action of the piston at the completion of its stroke, allowing time for the perfect condensation of the steam in the cylinder, before making the returning stroke.

1st. *Improvement on the Boilers.*—The quantity of water evaporated with one bushel of coal, was, according to Mr. Watt, somewhat more than 8 cubic feet, converting it into steam of 220°. Tredgold states, that he has evaporated 10 cubic feet*; 8 cubic feet is, however, found in practice, to be about the mean quantity evaporated by a bushel of coals with the common boiler. During my experiment at Wheal Towan, there was evaporated 310,824 cubic feet of water, or 13,824 by each bushel of coals; being an increase of steam generated by 1 bushel, as 13·824 : 8.

These improvements seem principally to be effected by the judicious mode of causing the heated air to circulate through the flues, so that, as it decreases in temperature, it is made to act on colder water, which will, of course, occupy the lowest part in the boiler. More caloric is thus abstracted from the current in the flues of such boiler, than where, as in the common boiler, the flues are constructed without regard to this effect.

It is, perhaps, impossible to ascertain how much of this increase of effect belongs to the management of the fire, and how much to the subsequent circulation of the caloric through the flues.

3rd. The expansion of the steam in the cylinder, by cutting off the communication with the boiler, after the piston has made a portion of its stroke. This is, perhaps, the most extraordinary feature in the steam engine; and the Cornish engineers, having pursued their inquiries on this subject with great accuracy, have been enabled, mainly by the extension of the principle within perfectly safe limits, to obtain the enormous advantages already stated.

The merit of this discovery is due to Hornblower, who, in 1781, obtained a patent for the invention. He states that "when steam is confined on one side of a piston, and a partial vacuum is formed on the other, the steam will move the piston, till its force be in equilibrio with the friction and uncondensed steam; and as much power as is communicated during this motion, is in addition to the ordinary effect of steam pressure." To gain power in this manner Mr. Hornblower used two cylinders, in which the steam was to act: employing the steam, after it had

* Treatise on the Steam Engine, p. 119.

acted in the first cylinder, to operate a second time on the other, by permitting it to expand itself; which he did, by connecting the cylinders together by proper apertures.*

Mr. Hornblower was, however, prevented from availing himself of his invention by Messrs. Bolton and Watt's monopoly for the improved mode of condensation being unexpired; and Mr. Watt, in the following year, obtained a patent for expanding his steam in one cylinder. Neither Hornblower nor Watt seems to have intended to use high steam, and the advantages were, therefore limited to the effect obtained by steam a little exceeding atmospheric pressure, being expanded until its effort was unable to overcome the friction of the machinery, and the resistance of the uncondensed vapour in the cylinder.

It was not till 1804, that *high* steam was used expansively. In that year Mr. Arthur Woolf obtained a patent for an alleged property possessed by steam. He assumed that steam of a force equal to any number of pounds above atmospheric pressure, would expand itself the same number of times its volume; and supposing no waste of caloric by radiation, would still retain an elastic force equal to that of the atmosphere. He states that he had proved by experiment, that steam of 40 lbs. on the square inch, would expand itself to 40 times its volume, and yet equal the elastic force of the atmosphere.†

The expansive property of steam is strictly mechanical and common to all fluids. It simply consists in this, that vapour, of a given elastic force, will expand itself to certain limits; and, during the process of expansion, will act on opposing bodies with a force gradually decreasing until it has reached the limits of its expansive force, or is counterbalanced by the resistance of a surrounding medium. If air, for example, be compressed in a close vessel, and suffered to act on a piston, it will give motion to the piston with a decreasing effort, until (supposing the absence of friction) the air in the vessel be in equilibrio with the surrounding atmosphere. In like manner, steam, of high elastic force, being permitted to actuate a piston during a portion of its stroke in a cylinder, and afterwards the communication which admitted it being closed, will expand itself until counterbalanced

* Repertory of Arts, vol. iv., page 396. 1796.

† Mr. Tilloch tried the experiments in conjunction with Mr. Woolf, by which the latter was led to conclude, that the expansive power of steam was in the ratio of its density in lbs. *above the atmospheric pressure.* They used in the experiment two vessels, whose capacities were proportionate to the anticipated expansive power, and found that an elevated column of mercury was restored to equilibrium, when the steam was admitted into the larger vessel. This experiment, however, is evidently imperfect, since equilibrium might have been restored by leakage or other causes. The expanded steam should have been made to *sustain* a column of mercury before any result could be obtained to be relied on.

by the atmosphere. But, if a partial vacuum be formed on the other side of the piston, its motion will then be continued until its density be as low as that of the uncondensed vapour on the opposite side of the piston. It is clear that the power which may be obtained by thus impelling a piston, is as the mean between the highest and lowest pressure on the piston.

It will be well understood, that it is saving, and not gain, that thus results: a power being availed of that was before lost. For, refering to the example of compressed air, it is true that, if the air be condensed so as to equal 20 lbs. on the square inch, and the supply be continued throughout the stroke, an impulse could be given to a piston equal to 20 lbs. per square inch, during its whole stroke; whilst, if it be cut off at a portion of the stroke, and allowed to expand itself, the impulse would only be as the mean = 10 lbs.; but it is evident that, in the former case, we suffer the air to escape from the cylinder at the same elasticity as it entered, and lose the whole of the force which was necessary to compress it to its density; while, by expanding it to its limits, we lose no part of that force.

It is easy to see that the advantages arising from expansion, increase with the density of the steam; for steam of 50 lbs. per square inch above the atmosphere being = 64, and steam of 10 lbs. above the atmosphere being = 24; we have, in the one case, a mean effect of 12 acting through 24 of space; and on the other, a mean of 32 acting through 64 of space, whilst the fuel consumed is nearly as the respective densities of the steam; ergo, steam of 50=64 lbs. gives a mean pressure of 32, expanding to 64 times the original bulk, before it reaches the limits of its expansive power; hence 32+64+2048. But steam of 10=24 lbs. gives a mean pressure of 12, expanding 24 times its original bulk before it reaches the limits of its expansive power, hence 12+24=288. In round numbers 64 of steam performs more than seven times the duty of 24 of steam; being in favour of the higher steam, nearly as 3 : 1.

4th. Covering or "clothing" the boiler, steam pipes, steam chests, and cylinder, with a non-conducting substance, to prevent the radiation of heat.

This, in many of the Cornish engines is so effectually done, that the heat in the engine room does not materially affect the thermometer. The radiation from the boiler is also, in many cases, scarcely perceptible. The merit of using clothing so efficiently, and indeed its first application with any useful result, is due to Captain Samuel Grose, on whose plans the engines at Wheal Towan are constructed, whose elegant arrangements of machinery, and accuracy of proportions, have enabled him to outstrip all his competitors. Since the year 1825, the period at which he erected his first engine, his improvements have increased the duty of a bushel of coals on the average throughout the country 40 per cent., and in individual cases more than 200 per cent.

The value of the advantages of clothing is variously estimated, nor am I aware that any experiments have been made of sufficient extent and accuracy to be relied on. Mr. R. W. Fox, of Falmouth, tried some experiments, and found that a slight covering of paint over his steam vessel effected a saving of one-fifth. Mr. Grose's method of clothing, however, may be said to be as perfect as is attainable, and its application at Wheal Hope without any other material alteration, increased the duty of one bushel of coals from 40 to 70 millions. Of this fact I have been assured by various disinterested parties, although it is asserted by other engineers that the advantage of clothing does not exceed an increase in the duty of one-fifth, or one fourth. I am, however, convinced that the improvement at Wheal Hope is always attainable, where the clothing is effectually applied.

5th. Suspending the action of the piston at the completion of the stroke, to allow time for the perfect condensation of the steam in the cylinder.

The increase of effect produced by this improvement is considerable, as the superior efficiency of engines for drawing water is dependent upon their power being greatest at the commencement of the lifting stroke, where more power is necessary to overcome the vis inertiæ of the matter raised, than to continue its motion. I have found that the best engines on the Bolton and Watt principle make about one-fourth of a stroke before condensation is completed; and, assuming that in the Wheal Towan engine the same time would be required, the mean decrease of effect would be 7 lbs.+·25 parts of the stroke, which, being deducted from 23½ lbs. (the mean pressure on the piston during the whole stroke), would amount to a loss of nearly one-tenth of the whole effect.

From the preceding investigation we shall be able to ascertain, tolerably nearly, the increase of duty assignable to each of the Cornish improvements.

Bolton and Watt's engines perform an average duty of raising 19,800,000 lbs. one foot high, with one bushel of coal.

As in the Wheal Towan boilers, one bushel of coals converts 13,824 cubic feet of water into steam, at atmospheric pressure, whilst the Bolton and Watt engine boiler rarely converts more than eight cubic feet into steam of similar elasticity, we have an increase of duty from the boiler alone as 13·824 : 8, which on 19,800,000 is equivalent to a duty of raising one foot high

lbs. 34,214,400

Increase of duty by using steam of 35 lbs. in the boiler, equal to 27 lbs. in the cylinder + 14 lbs. pressure above vacuum + ·25 parts of the stroke = 12·25 compared to steam of 6 lbs. in the boiler, equal to 2 lbs. in the cylinder + 14 lbs. pressure above vacuum + the whole stroke = 20; 12·25 producing a mean pressure of 23½ lbs.; and 20 a pressure of only 16 lbs., which gives an increase on 34,214,400 = ... 47,044,800

Increase of duty by Captain Grose's application of clothing, three-sevenths of the whole duty of 81,259,200 lbs.	34,125,371
Increase of duty by obtaining a more perfect vacuum at the commencement of the lifting stroke, by suspending the motion of the piston until the steam is condensed, equal to one-tenth on the whole duty	11,608,457
Total duty of one bushel of coal = lbs.	127,693,028

I am aware that more accurate experiments may detect errors in the proportion of duty I have assigned to each of these improvements; respecting the real amount of duty, and the cause of the increase, however, there can be no doubt, nor do I anticipate that my proportions will greatly vary from the truth.*

ECONOMY OF THE CORNISH STEAM-ENGINES.

By a Correspondent of the Nautical Magazine.

THE object of the following observations is to attempt to explain why an increase of work has been obtained in several steam engines at work in the mines of Cornwall since 1812; to open the question of how much coal is used in the Cornish engines compared with steam-boat engines; and also why the latter consume a quantity so much larger than is proportional to the disadvantages under which they labour. To the mines, the saving of expense in coal is the only important object. To steamers, the length of the voyage, dependent on the consumption of coal, is even more important than the saving of expense; though the short, quick stroke in two cylinders, and the change of motion by a crank, will invariably cause a greater comparative consumption of coal to the estimated horse-power, than the long, slow stroke of the single acting engine with the reciprocating motion applied directly through a beam to the pumps. The statement of work performed by the latter, is obtained by combining the number of strokes and the quantity of water lifted at each time, divided by the quantity of coal in bushels, and is always expressed by the number of million pounds weight of water lifted one foot high by a bushel of coal. In 1812, a comparative statement of the work of several engines was published by the adventurer, on the advice of Mr. Lane, and since that time a gradual but almost incredible increase of work, from 7 or 8 millions to from 60 or 90 millions of work, has been obtained from one bushel of coal. A counter is fixed on every bob, which registers the number of strokes, the key of which is in the possession of a person appointed (a son of Mr. Lane) to calculate and publish the monthly work of each engine. An account of the increased work has been published by Mr. Taylor in the mining review; who has proved the correctness of the engineer's calculations, by a reference to all the new mining accounts, and which show a propor-

* Abridged from the Repertory of Arts.

tional decrease of money paid for coal to that paid at a former period to 1812.

A great moral effect has been produced by the knowledge of each engine's work, tending to excite a spirit of competition among the engineers, and care and attention among the enginemen, or persons who manage the working.

The engines in the larger mines are generally made in them under the enginer's direction, and remain working under his control. Every advantage also has been taken of observation, to introduce improvements ; the most prominent and simple of which are, the use of circular boilers, and that of clothing the boiler, steam pipes, cylinder, &c. &c.

The circular boilers in large engines are generally three in number, being from 40 to 50 feet long, and 6 feet in diameter. The flue is within, and is extended throughout their whole length, and returned round them outside, allowing, from their very superior strength, the use of steam 20 or 30 lbs. to the inch more than, and exclusive of, the power of the vacuum, and an effective use of expansion in the cylinder.

Clothing the boilers, steam-pipes, and cylinder, prevents the loss of heat, and consequently produces a condensation of steam. This scheme for preventing the radiation of heat, has been in use for three years at Wheal Towan, where an increase of work of twenty millions was obtained, chiefly by a clothing of saw-dust. An experiment with the boilers of a new engine at Corrols was tried, and it required 24 bushels of coal to keep up the steam to its gauge fit for work, while the boilers were exposed. On being clothed in the common manner with saw-dust and 2½ feet of cinders, 5 bushels were found sufficient for the same period.

The supply of steam is cut off in the new engines at from one fifth to one fourth of the stroke of the piston, the remainder of which is effected by expansion ; so that the piston is brought up easily with 5 or 8 lbs. of steam, having the advantage of starting with 20 or 30 lbs. of steam, to overcome the inertia of 240 fathoms of pump-rods, balance, bob, &c. The steam acts on the top of the piston, and draws up a beam, one bob, the pump-rods, and water in the lowest lift; the weight of the rods in the descending or return stroke forces up the water in the other lifts by "plunger poles," a forcing pump similar to that used by Bramah in the hydrostatic press. A lift is a term used for a set of pump-rods between each cistern, from 30 to 40 fathoms. The size of the cylinder is from 40 to 91 inches: the length of stroke from 8 ft. to 10. 6. feet. There are many 90 inch cylinders ; but one mine, determined to have the largest engine, erected a 91 inch; a tolerable proof of the spirit among the engineers. The 80 inch cylinders are now more common, as the larger pump-rods are expensive, and so much water collects in case of an accident. A pump-rod of Memeh balk, 16 inches, being often snapped off

quite short, not from decay, a circumstance which is unknown in timber immersed in copper-water.

It is proper to state, that the Cornish engines in 1812 were in a most wretched state, as much inferior as they are now superior to the rest of England. These improvements, which can be added to all engines now in use, were unknown for many years out of this country ; and when heard of, met with disbelief. The names and merits of the respective engineers are well known, and will be appreciated elsewhere, whenever a fair inquiry is made into how much has been effected by them. Their engines are now in contract with those of Liverpool and Leeds, several in the lead mines in Flintshire, and one in the fens near Wisbeach. This last has so far exceeded its stipulated duty, that it is about to undertake to drain an additional quantity of land.

I shall now call attention to the counter for steam-boats, to register the number of revolutions of the paddle wheels, the key to be in the commander's possession, and a weekly entry made in the log, jointly with the bushels of coal consumed. The number of revolutions and the area of paddles to be combined, and divided by the bushels of coal consumed. Perhaps this plan would give a good practical mode of comparing the work of different engines, independent of the form of the boat, or the variable effects of waves and wind. And I feel no hesitation in affirming my belief, should steam-boat engineers ever publish a statement of their respective engines, that in three years from that period three-fifths or more of the coal at present required will be saved.

I have thus attempted to explain the mode adopted with the Cornish engines, aware of the advantages they possess in comparison with steam-boat engines, and equally convinced that the difference in the consumption of coal is far greater than is proportional to the respective circumstances under which they are worked.

GLASS BALANCE-SPRINGS TO CHRONOMETERS.

This novel invention is the conjoint labour of Messrs. Arnold and Dent, whose inquiries into the mechanism of chronometers, and the magnetic influence on them, can scarcely be too highly commended.

The following is the substance of the particulars of their invention, addressed to the *Nautical Magazine:*

"We beg to offer a few remarks on the imperfect state of the balance-spring of the chronometer, and to put you in possession of some experiments which we have lately made, tending to inquire how far glass might in this respect be substituted for metallic substances. The balance spring is a more important member in a chronometer than it is generally supposed to be. The isochronal vibrations of the balance owe their main source to its perfection ; in fact, the relation that gravity bears to the

pendulum of a regulator is conveyed by the balance spring to the chronometer. But its importance cannot be better shown than by referring to the rates of most chronometers, which are found to be affected by the simple circumstance of the difference in the metals which compose the balance springs. If we refer to chronometers Nos. 605 and 608, the rates of which were published by you in your Magazine for February, and compare them with Nos. 662 and 663, we shall find that the tendency of the two former is to lose on their rates, whilst the direct contrary to this is obtained in the two latter, by their assuming a disposition to increase on a gaining rate. The difference in the respective rates is attributable only to the consideration that Nos. 605 and 608 have both of them gold balance springs, whilst 662 and 663 have springs of hardened and well tempered steel. The proof of this consists in the fact, that, if the springs of 605 and 608 were applied to 662 and 663, and vice versa, the reverse effects would immediately result.

"There is also a difference produced in the rate of a chronometer, by the employment of a hard and tempered steel spring, compared with one made of soft steel. The former, as we have shown, produces a gaining rate, but the latter influences the chronometer in a contrary manner, and, like the gold springs, but in a greater proportion, causes the chronometer to lose. Two instances of the soft steel springs are to be found in Nos. 615 and 617, the rates of which were published by you in your paper to which we have alluded.

"The springs which are now, we may state, almost universally used, are composed of hardened and tempered steel; a fact which accounts for that increase on a gaining rate which is constantly to be observed in new chronometers. But this evil is only of a temporary nature, continuing generally for about two years. The trial at Greenwich furnishes us with many examples of this kind, where chronometers, which for two or three years have been on probation, and have failed from this cause only, and without being removed from the Observatory for the purpose of any correction, have, after this lapse of time, outgrown the evil, and at length succeeded in obtaining premiums. This is a great proof that the present state of Chronometrical Science is not discernible from the public trial of chronometers at Greenwich.

"The following is a tabulated view of the number of chronometers which have annually been deposited on public trial, from its commencement to the year 1831, by which may be seen the great proportion of those which have gained on their rates compared with those which have lost.

	Number deposited.	Gained on rate.	Lost on rate.
1822	31	25	6
1823	36	31	5
1824	31	27	4
1825	48	34	14
1826	59	38	21
1827	58	46	12
1828	70	62	18
1829	57	50	7
1830	73	61	12
1831	63	52	11
	526	416	110

"Another very important matter to which we wish to invite particular attention, is this circumstance—If we take several of the best chronometers at Greenwich, and compare their rates for a few days at the two extremes of temperature, we should find that both at the maximum and minimum, the rate will be a losing one. This anomaly cannot arise from any defect in the compensation, for if it were so, and the thermometer at the minimum and the rate then a losing one, we ought to have a gaining rate when the thermometer is at the maximum. But this is invariably not the case, so that we can only attribute the above named effect to the want of affinity existing between the metallic particles which compose the balance spring.

"This is a subject which is well worth the attention of the scientific chronometer maker, since it involves the existence of difficulties in the most important part of the adjustments of chronometers.

"There are several objections to be made to the use of the gold balance spring in a chronometer. One great desideratum is, that the balance spring should be formed of an homogeneous substance; but the difficulty with gold is this, that it requires more alloy, and in this state its liability to break is very great. The specific gravity also of gold is very objectionable, so much so, that it has not sufficient power to sustain itself; and when approaching the vertical position, the distortion of its cylindrical form is apt to destroy the centre of gravity of the balance, and by its continual state of tremor and agitation produces very wide extreme daily variation.

"Most of these evils are removed in the adoption of a steel spring; for instance, the specific gravity of steel being considerably less than that of gold, the errors in the extreme daily variation with steel springs are partially removed by their stability and retention of their true form. Still there are evils which the very composition of steel balance-springs introduce. But without entering into the question of the effect of magnetism upon them, which it will be our object hereafter to show, their great liability to rust is an insurmountable difficulty. The smallest particle of moisture by corroding the spring will deprive it of some degree of strength; and while it will cause the chronometer to lose on its rate, will also destroy its isochronism.

"There can be scarcely any attempt made to preserve the steel balance-spring from oxidation, that we have not tried.

"The experiments were all made on chronometers previously perfect in their adjustments for temperature. And we found on the application of any substance, whether in the shape of a metal, varnish, &c., that the previous perfect adjustments for heat and cold were so materially altered, as to convince us of the impracticability of applying any coating on the surface of the spring. On the whole therefore we conclude, that our objections to a metal balance-spring are well founded. We have tried every device in alloying gold and steel respectively with copper, silver and platinum, and after useless attempts to gain a spring void of the faults we have mentioned, we began to consider how we could remove metals from the question altogether. The fittest spring for a balance we conceived would be that composed of a substance very light in its nature, of great elasticity, and void of expansion as much as possible; moreover, that it should be free from oxidation. That which seemed to accord best with these notions was Glass; and after great trouble and expense, we have succeeded in making a very perfect spring of that substance.

"Supposing, however, that the glass balance-spring should not in the sequel answer our expectations, we shall still have the satisfaction of knowing that it will afford us the means of establishing a minimum of the loss of strength or elasticity in metals and substances, caused by heat during the course of some experiments which we are contemplating

"ARNOLD AND DENT."

In a subsequent number of the *Nautical Magazine* it is stated:—that "this invention of Messrs. Arnold and Dent promises to realize the most sanguine expectations that have been formed of it. By a comparison between it and a metal spring without compensation being applied to the balance, it has shown great advantages. In a range of 70° of temperature, from 30 to 100° of Fahrenheit, the metal spring varied 19 seconds, and the glass spring only 1·5 seconds, proving thereby that the compensation which is probably the most difficult element to introduce into the chronemeter with the usual steel spring, may be almost dispensed with in one with a glass spring. Messrs. Arnold & Dent have already shown the disadvantages arising from moisture, besides those proceeding from a change of temperature, to which the steel balance-spring is liable; and the invention of the glass balance-spring being calculated to remove all these entirely, may justly be considered as the most important feature of recent chronometrical science. We understand that it is not their intention to fetter this discovery with a patent, but rather to leave their invention to be improved on by their competitors in the trade, for the benefit of the science. While we cannot but admire this generous mode of proceeding, so different from the usual course adopted by the discoverers or the proprietors of any valuable improvement, we hope to see this spirited measure appreciated by the scientific world; and, that Messrs. Arnold and Dent may receive that patronage, when their invention shall be fully matured, and the merits of it fairly stated, to which they only are so justly entitled. We believe that it is their intention to apply to the Lords Commissioners of the Admiralty for permission to extend their experiments at the Royal Observatory, for the improvement of chronometrical science."

CARRIAGE WHEELS.

MESSRS. GIBBS and APPLEGATH have patented certain improvements in machinery for cutting out wood for carriage wheels, and for cutting and shaping the wheel.

The following is an outline of the purposes, and an indication of the means employed.

The frame or support of the first machine is of cast-iron. It is furnished with a spindle or mandril on which the stock or nave, or felloe, of the wheel is fixed. Working with the spindle, is a dividing plate with grooves or divisions radiating from the centre, which regulates the position of the mortice holes; a detent pin

is fixed on a pointed rod moving through guides, and connected with a crank which as it revolves, moves the detent pin to and from the spindle. A friction roller acted on by a rigger, moves the dividing plate, so that it is at one time forced into motion by the friction and roller, and another, held fast by the detent pin, while a boring or morticing operation is carried on by revolving borers fastened on shafts, to which a rapid motion is given. These borers move at the same time with the detent pin, by the action of an arm on the crank. When this operation is duly performed, the block is raised by a screw placed beneath for the purpose, and a lower set of bores are made till the mortices are long enough, and then they may be finished by hand.

The dividing plate must have as many grooves or radiations as the wheel is to have spokes.

A second machine is for the preparation of the spokes. When they are rough shaped the tenon is to be cut at the stock end. To do this there is an iron bed or frame, with carriages for each spoke; these bring the wood to two circular saws which cut the tenons at the required angle.

In a third machine, a variety of mandrils receive the spokes, and a cutter fixed on a carriage, is made to shape them spirally, by an action very similar to that of the circular saw.

There is a fourth machine to cut the tenons at the felloe end of the spokes.

A fifth to cut the ends of the felloes themselves; a sixth to bore the dowell holes in the ends of the felloes, and lastly, the spokes are fixed to the felloe, and that shaped by another series of machinery no less complicated.

In short, the wheel is begun and ended by these machines. The saving of labour, and, consequently, of expense and time, is enormous.*

PREVENTION OF FORGERY.

Messrs. Francis Peabody and Joseph Dixon, of Salem, Essex County, Massachusetts, have patented the following means for protecting bank notes, &c. from being counterfeited. The object had in view by the patentees is to prevent the counterfeiting of bank notes by means of lithography. Those acquainted with that art are aware that the impression upon a bank note, or other engraving, printed with ink into which oil enters as a component part, may be transfered on to stone, and the stone then used to furnish similar impressions on paper. The utmost perfection has been attained in this process, which, as it is merely mechanical, may enable one who is no artist to imitate the work of the best engravers in a way which shall defy detection.

The means by which the patentees effect their object is by taking printer's ink, or ink made from oil, which is to be of a

* Repertory of Arts.

pink, light blue or other tint, and which will serve as a ground for the black ink generally used in printing bank notes. The paper intended to be printed on is first covered wholly, or in part, with the light coloured oleagenous ink, and after this the notes are printed in black ink in the usual way.

Any attempt to make a lithographic transfer from paper so prepared must fail altogether, as every part which has either the tinted or the black ink on it, will affect the stone, and only a confused, blurred impression, can be obtained from it.

The claim is to the preparing of paper in the manner described.*

HINTS FOR PACKING UP MACHINERY, AND PRESERVING IT IN WORKING ORDER.†

BEFORE sending off the materials of engines, the bored or turned cast iron parts are all well greased, and the latter wrapped with rope-yarn, and the outside of the castings receive a coat of oil-paint; the polished wrought iron work is well greased and packed in boxes with dry saw-dust. The precautions do not, however, prevent rust for any great length of time: this was experienced in the materials of his Majesty's steamer, the Alban, which we delivered at Deptford-yard, in May or June, 1826; but the vessel not being ready, the boxes with the wrought iron goods were deposited in what appeared to be a dry store-room, and, as far as I recollect, the saw-dust removed. On proceeding to erect the engines, some six months afterwards, the wrought iron work was found to be much corroded by rust, and the repolishing and refitting was attended with considerable expense and loss of time. We find also that in our hands here, when similar materials are laid by for any length of time in the driest rooms we have, they require repolishing. This would be the case if the engines were erected, but we do not think the expense incured in keeping the parts in order would be much increased; indeed, I have adopted this plan myself in an iron work belonging to me, where I have had occasion to increase the power without the hope of letting it out in the present time. * * * If the engines are not to be erected, the boxes should be immediately opened, the saw-dust removed, and all the wrought iron work well cleaned and fresh greased. It should be kept in a dry store-house, and, if possible, in one occasionally heated; the cylinders, air-pumps, &c. should also be cleaned out and fresh greased, and all the castings as well as the boilers, should be put under sheds, to protect them from the wet.‡

* Franklin Journal, in Repertory of Arts.

† Extract from a letter from James Watt, Esq., of Soho, to John Barrow, Esq., of the Admiralty.

‡ Mechanics' Magazine.

SIMPLIFIED APPLICATION OF STEAM.

At a meeting of the Paris Academy of Arts and Sciences, held on 7th of January, a memoir was read, in which M. Pelletan treated of the dynamic effects of a jet of steam, and the means of applying it, in a simple and cheap way, to the purposes of the useful arts. "A jet of steam," says the author, "when thrown into a cylindrical conduit, or into a pipe filled with air, imparts the active power, with which it is endued, to the column of air, without any other loss than that occasioned by the friction in the conduit or pipe.

His detail of the results, which have already ensued from his discovery, are deserving of attentive notice. A jet of steam issuing through an orifice of a millimetre, (·03,937-100,000 of an inch) under a pressure of five atmospheres, posseses a velocity of five hundred and fifty nine metres (1084⅜ feet) per second; it consequently moves at the same rate of velocity as a bullet discharged from a gun.

But this enormous velocity is, in its simple form, of no practical benefit, in as much as it cannot be converted into a useful agent; when, however, the steam has been enabled to impart motion to a quantity of atmosphere, the velocity, it is true, is diminished, but the mass set in motion is increased; and, by this operation, the active power of the jet of steam is susceptible of general application.

The elastic force of steam has hitherto been employed under pressure, by the aid of machines, which are necessarily complicated, and involve a serious loss of power from their bulkiness and friction; but steam, acting immediately by its own power, can be made to effect its objects in machines of so simple a construction, that a steam engine of one man's power may henceforth be worked by a common fire

M. Pelletan remarks, that the force of steam, so applied, may be brought directly in aid of the mechanic, and will enable him to double and treble his gains, instead of its powers being limited as hitherto, to filling the coffers of great capitalists at a compound ratio.

The same jet of steam, when applied to the purpose of increasing the draft of furnaces, enables the proprietor to reduce their diameter to two inches, even where a large furnace is in question, to lead the smoke in any direction which may suit him best, and to make use of the whole heat produced. By means of this jet a vacuum may be effected at will; in any given space, however considerable it may be, and permanently maintained, not only at very small cost, but through the medium of an apparatus of the simplest construction. This process is of ready application wherever evaporation or dessication are to be effected. Acting upon a column of air, the jet supplies the simplest and most efficacious mode, which can be adopted for creating blasts in forges, furnaces, &c.

It appears that the inventer claims priority in this important discovery, inasmuch as he communicated the properties of the jet in a paper addressed to the Academy in 1829, and he is tenacious of the claim in consequence of the later application of the jet in impelling steam carriages in England.*

WIND MILLS.

Mr. John Burlingham, of Old Buckenham, near Attleborough, in the county of Norfolk, Miller, has patented certain improvements in mills, or machinery to be operated on by wind, and applicable to the grinding of corn and other purposes.

The patentee proposes to fill the area or circle usually described by the sails of a wind-mill, with any number of vanes, so as to form nearly a continued circle. Their centres set at any angle, or any eccentricity to the common centre of motion. The whole area, or circle, he would inclose at its periphery, with a ring or polygonal figure, the plane of which should be set at right angles to the plane of the vanes, or fans, or sails which compose the circle. The object is to catch a greater quantity of wind, to prevent the loss of wind at the extremity of the sails, to make tolerable a greater stress of whether, and of course, to increase the intensity of the power. The separate and distinct fans being set, each "covering," in military phrase, the edge of the other, are fastened in the usual manner into the tremendous cross or main beams of the mill's sails, which are common to all such contrivances. The pieces which form the polygonal figure, or ring at the periphery, are of delicate frame-wark, and covered with canvass.

The second part of the invention is an improved mode of striking the sails or vanes, that is, of turning them from the weather. For this purpose the usual rod and cross beam, or crutched head, is used ; but it is seconded with another similar rod and beam working below it, and the shaft of which is made the case of the first, both working in the wind shaft. These rods with their cross heads, are connected by crank pieces to the common centre, and again to an outer and metallic ring by pins, in such manner that the striking is very simply and certainly produced without delay or danger.†

HEATING BUILDINGS.

Mr. W. Daubney Holmes, has patented a new method of heating houses and other buildings; which invention may be described in few words. Oil and other substances boil at a higher temperature than water, and submit to the same laws of expansion and evaporation, by the application of heat. The sug-

* Athenæum. † Repertory of Arts.

gestion of the patentee therefore is, simply, to substitute oil or other liquid for water in the cases where water is now used as a means of heating houses or other buildings, &c. The mode of its application differs but little from that of water. Let us take for instance, an oven to be heated. Let it be placed within a jacket or case, to the top of which screw or fasten the end of a cast-iron pipe of dimensions differing according to the purpose. This pipe ascends perpendicularly for a few inches, then by a knee takes a horizontal direction for a few feet, it then resumes the perpendicular, falling along the side of the oven's outer jacket, where it is twisted into several coils; then proceeds horizontally to the underpart of the oven, which it enters by a knee that throws it again into the perpendicular position.

The oil is admitted into the pipe above the oven, where there is a funnel for the purpose, as also a cock to let off the air while the oil is poured in. The oil in the pipe is heated by the application of a furnace, or other means, at the serpentine part of the pipe; then, as it is heated, it expands, and arises towards the top of the oven, and entering the jacket performs the functions of the warmer quite in the usual way. The oil ought not to be heated above 400° of Fahrenheit.*

NEW RAILWAY FOR ANIMAL POWER.

APPLICATION has been made to Parliament for making a railway, on which animal power only will be used, from Whitby to Pickering in the North Riding of Yorkshire; the attention being the facilitating the conveyance of the produce of that part of the country immediately to the vastly improving and advantageons port of Whitby, instead of taking it to be shipped at Kingston-upon-Hull. From the prospectus issued by the committee formed to carry the line into execution, should the company succeed in obtaining an Act of Parliament, we gather the following particulars:—

This Railway, nearly twenty-four miles in length, is intended to connect the town of Pickering and the fertile district in its vicinity, which is rich in *timber* and *lime*, and also in *corn* and other *agricultural productions* with the sea port of Whitby; which on the other hand, will, by means of the railway, be rendered the channel for supplying the coal of the Durham and Newcastle district, and many other articles of import to an extensive and populous inland district.

That the proposed line of railway will afford to the public an easy and expeditious means of communication, appears evident when placed in comparison with that of the turnpike road; for whilst the turnpike road within six miles from Whitby rises in many parts very abruptly, and in one place as much so as one in six, the railway in no part of the six miles at either extremity of the line rises more than about one in four hundred; and though

* Repertory of Arts.

the intermediate part is not equally favourable, yet it is so decidedly superior to the turnpike road, as on the whole to make the comparative power of draught as at 12 to 1 in favour of the railway.*

POLISHING POWDER.

CERTAIN of the French manufacturers of polishing powder use in their manufacture scraps of old iron, which they put into a tub, and cause to rust quickly by sprinkling with water. When a sufficient quantity of rust has thus been formed it is collected by washing, and after allowing it to settle it is dried and calcined in a crucible. The longer the calcination is continued, the more the oxide approaches to a violet hue, and *the harder its grain.* At a very high temperature the oxide is partly reduced, its colour becomes more grey, and the grain too hard for polishing. The red oxide serves for polishing gold and silver, the violet oxide is fit for polishing steel. When taken out of the crucible, it is first triturated, and then levigated, in order to collect the finest parts.†

BREWING PRESS.

MR. JOHN SWAN of Basingstoke has patented this improvement in brewing. The object of his invention is to procure useful ingredients for brewing from hops which have already yielded their essence in the ordinary degree. The means of accomplishing this end is by a very high pressure, and by cutting and bruising the hops, in order that they may be subjected to repeated pressure. In many ways may this effect be produced. Mr. Swan proposes a press of very great power, to be secured in a room capable of being used as part of a brewhouse. The press must be strongly fixed to the floor. It works in a rim of proper material secured within another. From this outer circle proceeds a pipe to conduct the liquid expressed from the hops into the proper receptacle.

The press is of great weight, and its bottom is convex, and scored in channels as is the bottom of the vessel in which it works. These channels are to allow the liquid to pass off. The lever by which the press is raised may be worked by hand or by machinery. The vessel being filled with hops which have undergone the usual process of brewing, the press is made to work them, and the liquor is forced off into the conducting pipe. Yeast is submitted to a pressure in the same manner, and forced into cakes for the convenience of keeping. The claim is for the very high pressure, and for this means of applying it.‡

UNDULATING RAILWAY.

FEW inventions of the past year have more excited the attention of scientific men than the undulating railway, the subject of a

* Abridged from the Repertory of Arts.

† Journal des Connaissances Nouvelles. ‡ Repertory of Arts.

patent granted to Mr. Richard Badnall, and thus described in the specification :

My improvement in the construction or formation of the trams or rails, or lines of rail or tram roads, upon which locomotive engines shall or may work, will be best illustrated by reference to the oscillation of a pendulum.

Description of the Engraving.

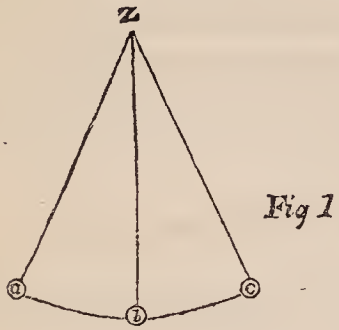


Fig 1

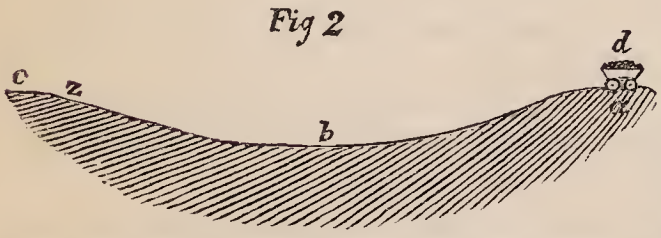


Fig 2

If a plummet suspended by a string, as fig. 1, from the point z, be drawn away from the perpendicular line to the point A, and there let go, it will fall by its gravity to B, in the arc A B ; but in its falling it will have acquired so much momentum as will carry it forward up to a similar altitude at the point c.

Let it be supposed that a line of rails or tram-way for carriages be so constructed from the summit of two hills, as fig. 2, across a valley, that the descent from one hill, as A to the valley B, shall subtend a similar angle from the horizontal line to the ascent up the other hill from B to C. Now if a tram wagon, as D, be placed at the summit of the declivity A, it will by its gravity alone, run down the descending line of rails to the lowest point B ; but in so running, according to the principles of the oscillating pendulum, it should have acquired a momentum that would carry it forward without any additional force up the ascending line to the summit of the hill C, being at the same altitude as the hill A. It is quite certain that this would really take place if the force acquired by the momentum was not impeded by the friction of the wheels of the carriage upon their axles, and upon the rails on which they run. Hence, subtracting the amount of friction as a retarding force from the momentum which the carriage has acquired in descending from A to B, it will be perceived that the force of momentum alone would only impel the carriage part of the way up the ascent B C, say as far as Z. It must now be evident the carriage D would not only pass down the descending line of road from A to B, by its gravity, but that the momentum acquired in the descent, would also impel it up the second hill as far as Z, unassisted by any locomotive power. In order, therefore, to raise the carriage to the top of the second hill, I have only to employ such an impelling force as would be sufficient to drive it from Z to C, the whole expense of locomotive power for bringing the carriage from A to Z being saved. If now I employ a locomotive power to assist in impelling my carriage from A to B, I by that means obtain a greater momentum than would result from the descent of the carriage by gravity alone; and am enabled by that means to surmount the hill C, having travelled the whole distance from A to C, on the undulating line of road, with the exertion of much less locomotive power than would have been

requisite to have impelled the carriage the same distance upon a perfectly horizontal plane.

Having now set out the principles upon which my improvement in the construction of tram roads or railways are founded. I desire it to be understood, that I claim as my invention, the forming of trams or rails, or lines of rail or tram roads in such undulating curve or curves as will enable me, in ascending hills, to combine and apply the advantages of momentum from gravity acquired in running down the descending curves of hills with the propelling power of locomotive engines to be employed thereon, not confining myself to any particular extent of line or form of curve, but varying and adapting the curve or curves according to the surface of the country, or other local circumstances.*

ALARM TO BE APPLIED TO THE INTERIOR FLUES OF STEAM BOILERS.

By A. D. Bache, Professor of Natural Philosophy and Chemistry in the University of Pennsylvania.

Both experience and theory point out sources of danger to which boilers with interior flues, are particularly liable. As economy will probably lead to the continuation of the use of these interior flues in boilers of certain sizes, means of safety should have reference to this particular kind of boiler, now in such general use, as well as to those of a different construction.

The following apparatus combines the requisities of giving warning when the temperature reaches a determinate limit; of not producing, necessarily, the escape of steam: of being free in its action; and of being renewed with great ease, after having given warning.

A tube of iron or copper, closed at the lower end, passes through the top of the boiler, its closed end reaching the flue, to which it is attached. The material of the tube will depend upon that of the boiler. This tube it will be observed, affords a ready access to the flue, to ascertain its temperature, without any restraint from packing. Such tubes were used by Dulong and Arago in their experiments on the elasticity of steam at different temperatures, (and also by the committee of the Franklin Institute on explosions,) to ascertain the temperature of the steam and of the water within their boiler. For this purpose, they were partly filled with mercury, into which a common thermometer was plunged, and thus conveniently placed or removed while its bulb was not exposed to the pressure of the steam.

A mass of fusible metal placed at the bottom of the tube, described in the beginning of the last paragraph, will become fluid very nearly as soon as the flue takes the temperature of fusion of the alloy. I would, in passing, note a point in relation to fusible alloys, which is of great consequence in these kind of applications, and which, from some experiments, I have reason to believe may be attained; namely, that the proportions of the component metals should be so adjusted that the alloy will change its state, from a solid to a liquid, without going through a series of slow gradations.

* Repertory of Arts.

The alloy contained in the tube might have its fusing point at 30° Fahr. above the working temperature of the steam. This, for a low pressure engine, working at two atmospheres, would allow a range of more than one atmosphere above the working pressure before it fused; putting out of the question the fusion of the metal by ordinary variations in the temperature of the water surrounding the flue. In a high pressure engine working at eleven atmospheres interior pressure, the fusing point of the alloy being placed at 30° above the working temperature, would not exceed 397° Fahr. Larger limits might be taken without incurring danger, should practice show that these are inconveniently small. The object not being to give notice when the steam is saturated and highly elastic, and the water, therefore, the same temperature as the steam, the fusing points of the alloys should be considerably above those of the plates attached to the boiler, and above the temperature corresponding to the pressure for which the safety valve is loaded. The case to be met by the apparatus is that in which the flue itself becomes unduly heated.

To show when the metal at the bottom of the tube becomes fluid, a stem is attached with a cord and weight, or, as shown in the annexed cut with a lever and weight. The weight and longer arm of the lever, in descending, may be made to ring the bell, or by appropriate attachments, to turn a cock, permitting just enough steam to issue to give the alarm, and then to be closed at once. A projection on the lower end of the rod prevents it from being drawn from the metal until this latter is fused, and by widening the lower part of the tube, making it slightly tapering, the metal is kept from being drawn out by the rod.

When the alloy has fused, indicating an undue heating of the flue, and its cause a defective supply of water, it is only necessary at the time of giving the required supply, to remove the weight, and return the rod to its position in the fusible metal, which, as it congeals, will inclose it: by replacing the weight, the apparatus is again prepared to do its duty. The solidifying of the metal will show when the temperature of the flue has been duly reduced. Should this be ascertained by sounding with the rod itself it might be drawn out just when the metal was in the act of congealing, and thus its return to its place be prevented. This would destroy an important quality of the apparatus, and to avoid such a chance, a wire should be provided with which to sound, for the purpose of ascertaining the state of the alloy.

In determining the position of the tube, reference should be had to the construction of the boiler. If the flue be inclined, the proper position for the tube, intended to meet the case of undue heating from a deficient supply of water, would be upon the higher part, as likely first to be laid bare. In reference to the deposit, different modes of construction would require different locations, which might render necessary a separate apparatus from the former.

For the use of the engineer, a second tube may be provided, at the side of the first, to contain an alloy fusing at a low temperature,* or mercury when it could be used into which a thermometer being plunged would show the temperature of the flue. A similar device, already alluded to, being conveniently placed, will give him the temperature of the steam within. If a thermometer be deemed too fragile an instrument to be

* Two parts, by weight, of bismuth, and one of tin, give an alloy which fuses at 200° Fahr. The fracture of the thermometer by the congelation of the alloy, in an open tube need not be feared,

used in this place, an alloy less fusible than the one used in the proposed alarm, may be similarly applied, its indications being given to the engineer alone. Before refering to the cut for a detailed explanation of the apparatus which has been, in a general way, described, it may be well to pass in review some of the points which should meet with attention in its construction.

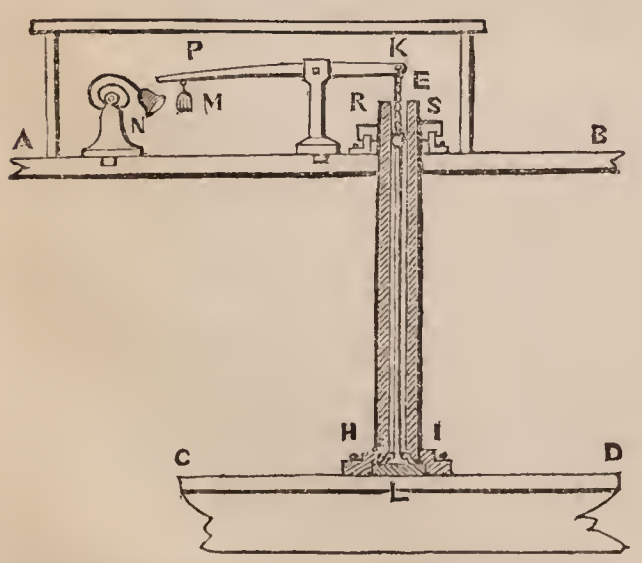
Of the first importance is to be considered the connexion of the tube with the flue, so as to prevent the introduction of sediment between them. This may be accomplished, among other ways, by providing a projection at the bottom of the tube over which a ring being passed, (as shown in the cut) and secured to the flue, will attach the tube closely to the latter. If the tube, thus connected with the flue, should pass by a screw joint, through the top of the boiler, any change in the position of the flue would tend to separate the attachments of the tube, or the parts of the tube itself. To provide against this, the tube should pass through a stuffing box on the top of the boiler; this would allow it to move, the fastening to the flue remaining firm. This box, it should be observed, is in nowise connected in its action with the parts of the alarm. The movement of the tube will render necessary a small allowance in the position of the lever with respect to the bell.

The tube should be made as small in diameter as is consistent with the free action of the rod. The water is excluded from the space on the flue occupied by it, and if this space were considerable, the temperature of that part of the flue would be higher than that of the rest. The tube must be so small that the metal may not fuse when the flue is covered with water.

If a bell be used in connexion with the stem and lever, the weight attached to the longer arm of the lever should enable it to raise the rod, and to overcome, with certainty, the resistance of the spring to which the bell is fastened.

A cover should be used to prevent the access of rain to the tube, and the whole apparatus should be inclosed in a grating that it may not be tampered with; the captain of the boat should have the key of this grating.

If this apparatus were applied to the connected boilers of our western boats, the frequency of the action of the alarm, when the flues become bare by the careening of the boat might lead to a neglect of its indications. The apparatus would then merely give notice of what ought to be known without it, namely, that the higher boiler, or boilers, have a defective supply of water, and are then becoming unduly heated.



Annexed to the cut, which follows, are references giving a more detailed description of the apparatus.

A B is a section through the top of a boiler; C D, a corresponding section of its flue; E H represents a tube closed at the lower end, which is attached to the upper side of the flue. The

mode of attachment by a projection on the tube and a ring screwed to the flue, is shown in the cut; as also the stuffing box, R S, through which the upper end of the tube passes. The lower part, H I, of the tube, is made tapering, to retain the fusible metal. K L is the stem, the lower part being inclosed by the fusible metal, the upper part attached by a chain to a lever K L. The weight M draws the rod K L upwards, and on the fusion of the alloy H I carries the lever below the bell N, which being attached to a spring, rings an alarm.

The apparatus is inclosed in a grating; that part of the top which is above the tube should be so made as to prevent the admission of rain to the tube.

ECONOMY OF MECHANICAL POWER.

THE following interesting facts and observations are abridged from *the United Service Journal*:—The *acme* of power obtained from the elastic force of steam is in Cornwall, where sixty-seven millions pounds weight of water have been raised one foot high in a minute. The machinery now used in vessels is certainly efficient, but its weight and dimensions render it unprofitable, and neither Government nor individuals seem inclined to adopt the most obvious improvements. No one can deny the corrosion from the use of salt water; but although an ingenious man, named Humphreys, has actually used the same fresh water for three years in the boiler of a steamer between Southampton and Cowes, and the Admiralty are aware of the fact, no means have been adopted to render the discovery available for general purposes. The Steam Navigation Company are also aware of it, but factious opposition among the Directors has prevented the adoption of an improvement which would have given them pre-eminence over all the establishments of the world. Too much space is occupied in all steam-vessels by the machinery. We know that the same machinery which propelled Ogle and Sumner's carriage to Liverpool, would propel a boat of forty-horse power. The whole machinery might be comprised in a box five feet square—now it occupies two-thirds of the vessel. The Royal Yacht squadron have so great a horror of science, that, by their laws, any member who possesses a yacht propelled by steam is expelled.

If people can travel on the common roads without smoke or steam, their machinery would produce the same result on the ocean. If a boiler was objected to, Howard has an engine at work without a boiler, and the fire is contained in a close metal box. This engine cannot be worked at much beyond ordinary pressure, from quicksilver being used to regulate the heat; but it ought to be tried, and brought into competition with others. A race of six or eight of such vessels, to be propelled without sails, without smoke or steam, and without being subject to the vibratory motion, would be both interesting and useful. The vibratory motion does not arise from the back water; but from the blows of the paddles as they strike the water. If they entered

edgeways and came out edgeways, the motion would be imperceptible. Until great improvements are introduced, steam ships for war are extremely defective. If the chimney of a steam frigate were to be shot away, the vessel would become a log in the water, very likely to catch fire. If a shot was only to strike her boiler, and not perforate it, the boiler would leak at every rivet and be worthless; if the shot penetrated, the probability is that the people below would be smothered or scalded to death. The boiler in present use is too much exposed. It should be so compact, that it may be fixed very low down, and be rendered quite secure from shot by being below the water, and surrounded by shot-proof substances. If properly constructed, the nitrogen tube would be so small as to run less risk than the present chimney of being shot away, and there should be provision for shipping another if it were cut away close to the deck; if a few feet above it, the injury would not be perceptible. The engines and boiler would be protected by the same materials, and if such a vessel had the power to condense and heat air, they might pour such broadsides that no ship could swim for ten minutes opposite a steam frigate of 800 tons. Should another war ensue, no army will be without some locomotive vehicles to be propelled by steam. The machinery may be easily secured against musketry or grape, and the top sides also. There are gallant spirits enough to be found who would steer them. Suppose one of these vehicles, containing two hundred men, rushed at a square of infantry, drawn up on a road like that which bisected Waterloo, and was followed by cavalry, the square would be broken through as if made of paper—what must ensue is evident. If the ground were hard so that the wheels had a fulcrum, columns would be scattered like pea sticks. The weight of the vehicle, to do such desperate mischief, need not exceed a twelve-pounder and its apparatus.

The Earl of Dundonald has lately made some very successful experiments with rotatory engines applied to carriages and boats. If the members of the Royal Yacht squadron were imbued with the same scientific spirit as Lord Dundonald, we should soon see vessels, like swans or flying fish, darting over the surface of the waters. It has been repeatedly shown that railways can never compete with canals for the transport of very heavy goods. If canal property was efficiently managed, it might in every instance compete with railways in this respect, when they are placed in juxtaposition. The rate of speed on the Ardrossan and other canals, though upwards of ten miles an hour, is not its maximum, it is limited by the speed at which the horses can continue the exertion. The use of horses in canals may be dispensed with altogether, and by the introduction of steam power, a maximum of speed, hitherto deemed impossible, may be accomplished in canals which are adapted for it. The outcry about the banks of canals "is much ado about nothing." If boats were commo-

dious and well conducted, the majority of persons would prefer travelling by them, as on the Ardrossan, where 67,000 people have walked half a mile rather than pay the extra three-halfpence by the coaches. There is one piece of machinery, long known, but just struggling into existence, which, like some unexpected blessing, will for a long time give a mercantile superiority to England. This is the mode of transfering power. As our object is to convey information in the simplest form, we will first state one or two facts through which the chain of reasoning may be more readily followed. The air presses on every square inch exposed to it the weight of fifteen pounds. It is clear that if a vacuum be formed on one side of a surface, the edges of which fit so close to an external box as to prevent any air passing, that if the vacuum be perfect, the number of pounds pressing on the side opposite to the vacuum will be fifteen times the number of square inches of the area. On that simple principle depends the working of the beautiful machine to which we allude. Suppose a mountain torrent so situated that it cannot be conveniently made use of, the water, by this machine, can be conveyed through swamps and other precipices, to the manufactory where it is required. Water-wheels are made to work exhausting pumps ; to these pumps a pipe is attached, which is exhausted of air by their working, and the air continually entering on the other side, forms the pressure desired. The communication with the vacuum is then changed to the side which contains the air, and the reciprocating motion being obtained, it is converted in the usual way to rotatory. Thus, at the distance of miles, the primary power is transfered by this simple, yet philosophical principle. Ships, by this power, may be cleared of their cargoes at half the expense, and in half the time. Had the proprietors of St. Catherine's Docks established it by the water of the Thames, they would have doubled their dividends ; but immense expense was incurred for engines little used, and cranes not half so efficient. When the Mersey is made use of for this mighty purpose, the Corporation of Liverpool may let out power, and mete it, too, as the Companies do gas. The Mint works of Utrecht and Brazil are, perhaps, the finest pieces of machinery in the world, and they are both worked by the vacuum machines constructed by John Hague, who has a patent for the application. Foster, of Stourbridge, has one at work 600 yards down a mine. As we never had an anchor properly faggotted in any of our dock-yards, the Government would do well to have some of these machines brought into use for working tilt hammers. In conclusion, it should be remembered, that machinery cannot be put together like the framing of a house. The ingenuity of England, and the wealth of the Bank, could not construct such vessels and weapons as we have spoken of, in less time than many months.

COATING LEAD PIPES WITH TIN.

THE following improved processes for this purpose are the subject of a patent granted to Mr. Thomas Ewbank, of New York, dated May 18, 1832. Take the lead pipes, *after they have been drawn to the required size*, and coat them with tin, either on both sides or on the inside only, as may be desired. To do this prepare a bath of melted tin, in a vessel of a suitable form and size, which may vary according to the size of the pipe to be tinned. Regulate the heat of this bath, so that the tin shall continue in a fused state, without becoming sufficiently heated to melt the lead. This may be ascertained either by the use of a thermometer, or by testing it by a piece of lead, or by such a mixture of lead and tin as will fuse at a given temperature: with a little experience, however, a workman will not find any difficulty in accomplishing this object without such aids. When the pipe is to be tinned on the inside only, cover the outside with lampblack and size, or with any other article which will prevent the action of the tin upon it; then blow powdered rosin into the pipe. When it is to be tinned on both sides, the rosin is to be blown, or otherwise passed into the pipe, and the outside also is to be sprinkled with it, and it is then ready for the process. The melted tin should be kept covered with rosin, fat, or other suitable article, to prevent its oxidation, and to aid in the tinning. All that is necessary is then to pass the pipe through the melted tin, which, when the pieces are not of considerable length, may be easily managed by hand; or when of considerable length and weight, a rope and pulley, or any other suitable mechanical contrivance which the workman may prefer, may be resorted to. The coating of lead pipes with tin, simply, is not new, the same having been heretofore done, but in a manner less perfect than that which has been just described. The lead has been tinned in sheets, and afterwards made into pipes, or the pipes have been made and tinned, and afterwards drawn to the intended size. By neither of these processes, however, is the intended security obtained with the same certainty as by this process of tinning the pipes *after* they are otherwise finished. The coating of tin is thus rendered more perfect, and those fissures are avoided which the former processes can scarcely fail to produce.*

COATING IRON CASTINGS WITH TIN.

The author of the process for this purpose is also an American—Mr. Isaiah Lukens, who gives the following account of it in a letter to the *Franklin Journal*:—

"The surface of the casting is first to be made perfectly clean, by turning, or scraping away the outside. Filing does not answer as well as turning or scraping. Make an amalgam of tin with mercury, containing enough tin to form a soft solid, say of the consistency of butter at 60°. Prepare a dilute solution of

* Franklin Journal, quoted in the Mechanics' Magazine.

muriatic acid; the muriatic acid of the shops diluted with about an equal weight of water, will give an acid of convenient strength. Heat the casting until so warm that on a further addition of heat it could not be held conveniently in the hand. Dip a clean linen rag into the dilute acid, and wash with it the surface of the casting where it is to be tinned. Upon another piece of clean linen take up some of the amalgam, and pass it over the surface which has been wet by the acid. A portion of the amalgam adheres; by rubbing the tin is precipitated upon the surface of the iron to which it is united, and the surface is tinned; after which the article should be immersed in a bath of melted tin and rosin to perfect the coating. The explanation I take to be this. The diluted acid, aided by heat, acts upon the casting, forming a chloride of iron; when the amalgam is presented to this, the chlorine leaves the iron to combine with the mercury, and the iron and tin are precipitated in very intimate union if not in chemical combination. I do not mean to lay particular stress upon this explanation; the steps of the process are detailed just as I have frequently taken them.*

MACHINE FOR MANUFACTURING PINS.

Among the recent American patents, described in the *Franklin Journal*, is the following for manufacturing pins, by Mr. John J. Howe. In the ordinary mode of manufacturing pins, the wire is first straightened in considerable lengths; these wires are then cut, a number at a time, into lengths of six or eight inches; the next operation consists in pointing these wires at both ends, which is also effected a number at a time; as many of the wires as can be conveniently laid upon the index finger, be held down in a row, and rolled over by the action of the thumb, are brought into contact with stones, or file-cut disks of steel, in rapid motion, and thus pointed, the same operation being performed on each end. The length of a pin is then cut off by an apparatus again operating on a considerable number, and the pointing and cutting are thus repeated until the whole wire has been used. The operation of heading is performed upon each pin singly; the twisted wire is slipped over the pin, and receives three or four blows in the heading apparatus, which fixes it firmly in its place. With the exception of this last, all the processes are performed upon many wires at one time. Several machines have been made for the purpose of manufacturing pins; in some of them the heading has been performed like that of cut nails, by heading dies forcing up a portion of the wire of the shank, so as to form the head out of the solid stuff; the pointing, the cutting off, &c. have also been performed in the same machine. In that the description of which is before us, "the wire is straightened, cut into lengths, headed, pointed, and the pin delivered from it in a state ready for whitening." Although upon each individual these

* Quoted in the Mechanics' Magazine.

operations are performed successively, they are going on simultaneously upon different pins. Such a machine is of necessity complex, and the full exhibition of its manner of operation would require a considerable number of drawings. All we can at present say upon the subject is, that we have seen pins which were manufactured by it, and which were good, although they were the early products of the first imperfect machine. We hope soon to hear of the apparatus being in full operation, as, from the ingenuity of its construction, and its promising appearance, we think it worthy of a fair trial. The principal questions respecting it which remain to be settled are, whether, as the pins are made individually, that rapid motion can be given to the machine, and the pins be transfered from one part of the apparatus to another, without interfering, so as to deliver them in sufficient numbers to warrant this mode of making them; and whether, from accidental defects in the wire, or from other causes, the parts of the pin will not sometimes take a wrong course, and obstruct the action of the machine. This is not an unfrequent accident in complex instruments which are to perform a considerable number of operations upon the same article. Whitney's card machine, however, may encourage us on such a question.

APPARATUS FOR PROTECTING SHIPS FROM LIGHTNING.

To effect this object, a truck made of glass is to be placed on the top of the upper mast; and upon each of the mast-head caps, covers of glass from half an inch to two inches in thickness are to be placed. These non-conductors being so placed, we are assured that the commanders of vessels may bid defiance to Jove himself, as they will be "completely secured" against his attacks. We are likewise told, that whenever lightning strikes a mast, it always enters at top, disdaining to enter sideways, and that "as the lightning rod of iron attracts and conducts when on perpendiculars, so will glass repulse and protect similarly situated." Notwithstanding the logic of this conclusion, we are still unconvinced. We should place just as much confidence in a glass nightcap, or a bonnet of the same material, to protect the person against the attacks of the thunderer, as we should in these caps to ward off his blows upon the head of a mast. The fact is, that the whole thing manifests an entire absence of information respecting the nature of the power or agent, a defence against which it is proposed to furnish. The best and the only known security in such a case is a good and continuous metallic conductor.*

MR. J. O. N. RUTTER'S PATENT PROCESS FOR GENERATING HEAT.

The ordinary process of generating heat, whether it be in a domestic stove, or in an inclosed furnace, implies the occasional

* Franklin Journal, quoted in the Mechanics' Magazine.

addition of some kind of fuel; the combustion of which is effected through the agency of oxygen, one of the elements of atmospheric air.

To obtain the greatest quantity of heat from the smallest quantity of fuel, is a problem that has long occupied the attention of practical men. In our endeavours to solve it, not only do the size and construction of the furnace, the arrangement of the flues, and the properties of the fuel employed, demand our attention; but the egress of air must be so regulated, that, whilst one-fifth of its volume, by combining with the fuel, contributes to the extrication of heat, the remaining four-fifths shall not deprive us of the beneficial effects of that heat, by carrying it off at the chimney.

Combustion, as usually conducted, denotes the union of carbon, hydrogen, and oxygen, in various proportions. That these materials combine only to a very limited extent, is attested by the volumes of smoke that we witness ascending from the shafts of factories. This waste of fuel it is exceedingly difficult to prevent. The exposure of a furnace to a current of air, through the frequent addition of fuel, is found unprofitable. Hence it is the general practice to throw on, at one time, more fuel than is really necessary, entailing periodical waste and variableness of temperature.

It was during the winter of 1832-3, whilst occupied in the management of the gas-works at Lymington in Hampshire, recently erected there by Messrs. John Barlow and Co., that the patentee had an opportunity of making daily observations on the process of heating thus briefly described. As is the practice in most of the coal gas-works in the kingdom, the tar made on the station, for which a ready sale could not be found, was consumed, in conjunction with coal or coke, as fuel. Experience taught him that, whilst on the one hand it was a measure of economy thus to get rid of an article, the accumulation of which might prove both offensive and dangerous, yet, on the other, its employment as fuel, by the means hitherto adopted, was a most wasteful process; since two-thirds, and in many cases three-fourths, of the tar sent into the furnace, was evidently not consumed. Reasoning on the results of various experiments, and assured by them that the imperfect combustion of so inflammable a body as coal tar was entirely due to an excess of carbon, it occured to him, that since water by its decomposition, yields hydrogen and oxygen, that fluid, if decomposed in contact with the tar, would render its combustion complete.

The first experiment was successful. By delivering into a furnace in which was a clear fire made with coal or coke, coal tar in a very fine stream, accompanied by an equal quantity of water, it was found that the whole of the tar might be decomposed.

From the experiments and observations of the patentee, and from the communications made to him by others on whose testimony he can rely, he believes that, under the old system of

burning tar as fuel, from forty to fifty gallons may be assumed as a minimum supply for one furnace during twenty-four hours. In some cases the consumption, or rather the waste, has been at the rate of seventy gallons during the same time. By a series of comparative experiments, conducted by the patentee at Lymington, and subsequently at Salisbury by J. Barlow and Co., it has been demonstrated that from eight to twelve gallons of tar, in conjunction with water, (varying in their respective proportions according to circumstances,) are sufficient for twenty-four hours; the latter quantity enabling the retorts to be worked at four-hours' charges.

At Lymington the patentee has made, during successive weeks, with one twenty-two inch York D retort, 3,800 cubic feet of gas from eight bushels of Newcastle coal (eighty pounds per bushel,) in twenty hours; which is at the rate of 13,300 feet per ton, and 17,100 feet per chaldron. A greater quantity of gas obtained from a given quantity of coal, as compared with the usual products in gas establishments, is not the only advantage consequent on these workings. The gas made under these circumstances is of superior density. In many instances its specific gravity has averaged ·550. At Salisbury nearly similar results have been obtained. With three twelve-inch D retorts, 7,800 feet of gas have been made from eighteen bushels of Newcastle coal in twenty-four hours; averaging 12,124 feet per ton, and 15,600 feet per chaldron.

The heat generated by the combustion of tar and water, although much more intense than that arising from ordinary fuel, may nevertheless be regulated at pleasure. It is, moreover, uniform in its effects,—a point which can only be appreciated by the practical gas-maker.

Let it not be infered that the exalted temperature exhibited in this process depends simply on the entire combustion of the tar. Water, by its decomposition, affording materials whose heating properties are inconceivably more energetic than the ordinary kinds of fuel, and its elements combining readily with carbon, it is easy to comprehend how these materials mutually aid each other. The quantity or intensity of heat generated by a comparatively small quantity of fuel, is due, therefore, to the presence of water.

Another condition of the process should not be overlooked. It has already been hinted that oxygen constitutes only one-fifth of the air admitted to a furnace, the remaining four-fifths taking no part in the ignition of the fuel. In the process here described, oxygen, instead of being admitted in any great quantity from *without*, is generated *within* the furnace; and instead of its being accompanied by azote, which retards combustion and extinguishes flame, it is accompanied by hydrogen, one of the most inflammable of the gases.

The importance of this process in gas operations has been first

mentioned, because to that department of science it owes its origin, and, up to the present time, the greater part of the proofs illustrative of its utility. There is, perhaps, no purpose for which heat is required in an inclosed furnace to which this process is not applicable. Steam-engines, whether stationary or locomotive, breweries, distilleries, glass-houses, the caboose of the merchant-ship, and the galley of the man-of-war, are favourable situations for its employment. The absence of smoke, also, gives to it additional importance in cases where the ordinary process is considered a nuisance.

Time and experience will doubtless unfold many valuable suggestions. All the patentee's experiments have been conducted in furnaces of the ordinary description. In the construction of furnaces much yet remains to be done. In the place of such a widely-extended stratum of fuel as is now required under steam-boilers, &c., a surface just sufficient to effect the decomposition of the materials will answer every purpose.

A condition peculiar to a furnace for heating gas-retorts is the great extent of heated surface to which the fuel is exposed. Under such circumstances, it is found that tar, both mineral and vegetable, will take considerably more than its bulk of water in its combustion. In a furnace over which is set a boiler, the only decomposing surface is that formed by the sides of the furnace and the fuel on the grate-bars. The relative proportions of the inflammable body, and of water, necessary in such cases, vary materially. In three experiments on board the "Glasgow" steam-packet, it was found that about equal quantities of tar and water were consumed. The sides of the furnaces in that vessel form a part of the boiler, consequently their temperature never exceeds that of the contained water.

To estimate with accuracy the relative heating properties of the materials applicable to this process,—which comprise bituminous, oleaginous, resinous, waxy, and fatty substances, in a fluid state,—as compared with coal and coke of various kinds, and other fuel, will require an extensive series of experiments. It is earnestly desired that practical men will make known to the patentee, from time to time, the results of their observations. That kind of information will enhance the value of the process by rendering its conditions better understood. With every desire to be on the safe side, he does not hesitate to affirm that, if the process be properly conducted, fifteen pounds of coal tar (weighing about eleven pounds per gallon), or the same quantity of Stockholm tar, with rather more than an equal bulk of water and twenty-five pounds of Newcastle coke, will be found equal to 120 pounds of Newcastle coal.

The cost of the process, as compared with that ordinarily employed, must necessarily depend on the relative cost of materials. In situations where coal, or other solid fuel, is plentiful and

cheap, it is but reasonable to expect that the old system will be perpetuated. Not so where fuel is scarce or dear.

There are situations in which the relative cost of materials does not constitute the *only* consideration. For steam navigation, and especially in long voyages, fuel is not simply a question of cost, but of stowage. The period seems now fast approaching, when communications by steam may be established with every part of the globe.*

IMMENSE WOODEN BRIDGE.

THE model of a bridge is to be seen at the National Gallery of Practical Science, which was constructed of fir, at Terrebonne, near Montreal, and was of no less than 750 feet span. It consisted of a system of trusses in a longitudinal direction, the feet of each being supported from the crowns of the bent arches, which were in thicknesses scarfed together, and thus the feet of the adjoining trusses were supported from the crown of the bent rib immediately thereover, as in a common truss. Owing to the iron washers under the main beams, which received the bolts of the suspending rods, being of too small an area, the bridge sunk four feet in the centre. As this was a fault of construction and not of principle, it was remediable, and larger washers were about to be substituted, for which purpose piles were driven into the river bed, to carry the bridge whilst the work was proceeding; but before it was completed, one of those floods which are of such frequent occurrence in the St. Lawrence, carried away the temporary supports, and the bridge itself was consequently destroyed.†

GLASS HONES FOR RAZORS.

SUCH a form is directed to be given to rods of glass as may be deemed best, a convex surface, however, being preferable to a flint one. The faces of the glass hone are "to be rough-ground or frosted by any of the usual means, and a grain differing in fineness may be given to the respective sides." Upon the glass hone, so prepared, the razor is to be rubbed in the usual way, the hone being first moistened with water or oil. A slight trial, upon a roughened glass tube, has afforded a very favourable result.‡

CLARIFYING SPERM AND OTHER OILS.

THE agent is heat, applied through the medium of steam, or boiling water, in suitable apparatus. The oil is to be put into a tin kettle,

* Inventer's Prospectus. † Mechanics' Magazine.
‡ Franklin Journal, quoted in Mechanics' Magazine.

which fits into a copper or other boiler, by which it may be surrounded with boiling water or steam. A close cover is to be fitted on to a tin kittle, and openings made for supplying water and oil, and also for the placing a safety valve. Oil kept at a moderate heat in this way, will, it is said, be clarified in a few hours, a portion of the foreign matter rising in scum, and another portion precipitating. During the process, the rising scum is to be removed. The patentee states, that one great advantage of his procedure is, that it can be followed at all times and seasons, whilst the refining of oil by exposure to air, and the direct rays of the sun, is restricted to fine weather, and a limited portion of the year. This process admits the use of caustic ley, sometimes employed, in which case the ley is to be thoroughly mixed with oil before the heat is applied.*

FRENCH CHRONOMETERS.

THE following translation of notice published by the Depôt de la Marine, at Paris, announces a determination to establish a method for supplying the French Royal Navy with Chronometers. We have taken it from the *Astronomische Nachrichten*, into which it was copied from the *Moniteur*.

There shall be established a competition every year for the supply of chronometers required for the service of vessels of the State.

This competition will be conducted by a commission, consisting of naval engineer officers, over which the director general of the depôt shall preside.

It will be opened on the 1st of June, and will continue from six to seven months, during which the chronometers presented will undergo various trials, which are here detailed.

Every chronometer presented to the collection will be first sent on trial to the Depôt de la Marine for one month.

After this first trial, the commission will decide which chronometers shall undergo further trial.

Those chronometers which are chosen shall be sent to the naval observatory at Brest, where they will remain for a month, submitted to the examination of the director of that observatory, who will send to the committee tables of their rates.

They will then be sent on board the (Vaisseau-ecole) college-vessel, moored in the road, and will remain either on board this vessel or on board the corvette of instruction for two months, during which they will be proved in every way. Care will be taken, that an exact register be kept of every circumstance which may alter their rates. The register of this, and the table of the rates of all the chronometers, will be sent to the committee at the end of two months, and the chronometers will be returned to the observatory at Brest, where they will again undergo a month's trial; after which they will be sent to Paris, with the tables of their rates.

* Quoted in the Mechanics' Magazine.

At the Depôt de la Marine they will undergo a further examination of one month, when the committee will decide on those which shall be reserved for the service of the navy. Their decision will be made public.

The necessity of subjecting chronometers to the least possible motion renders it necessary to prescribe the condition, that all presented should wind up on the face (se monter par dessus.) It will be likewise as well that the movement B* may be stopped by a particular mechanism, in order that they may be set going after the carriage, without its being necessary to give them a circular movement, which is always dangerous. This last arrangement will not, however, be indispensable.

The durability of chronometers being one of the most essential advantages to be desired, all parts of them susceptible of injury by friction should be jewelled; but as the verification of this cannot be made without taking the chronometer to pieces, an assertion to that effect, in writing, by the artist, when he deposits his chronometer for competition, will be sufficient—the committee reserving the power of making, in the presence of the artist, every verification to this effect which they may consider necessary.

If it be found by the report of the commission that the number of chronometers declared admissible be greater than the funds destined for the purpose will purchase, the proprietors of those which cannot be taken may present them the following year, and they will be excused undergoing a second examination on board, by keeping them constantly going at Paris, and being accessible to the committee, who will satisfy themselves from time to time, of their condition. The regularity of their rates will be then still more satisfactory than the first time.

If, during the course of these trials, an accident happen to a chronometer, which cannot be attributed to the bad construction of the machine, the maker will be entitled to an indemnity, the amount of which will be determined by the committee, according to the supposed value of the chronometer, if it be entirely destroyed, or according to the price of the repair, if it should have received damage only. 2474 francs (£103) will be allowed for chronometers admitted. This price, however, being susceptible of change, will be specified at the announcement of the competition each year.

LEAF HOLDER.

Mr. J. W. Durrant, of Somer's Town, has invented and patented the following simple and efficacious mode of securing, combining, and preserving printed, written, or plain papers, prints, drawings, music, &c. so as to be readily accessible, easily refered to, and capable of be being taken asunder and replaced at any time with facility.

Two pieces of steel, brass, or other metal, of the length of your portfolio, are to be connected by two cross-pieces or bars of the same metal, attached to each by rivetting, or by some other method which will allow of a free action. One of these cross-pieces must be long enough to fall on the opposite side-piece; and the other short, so as to be secured to a screw-nut in the centre, which is formed by a rod of like length with the two side pieces; and having wrought on it two screws, their spires working

* Something appears to be refered to here which was not given.

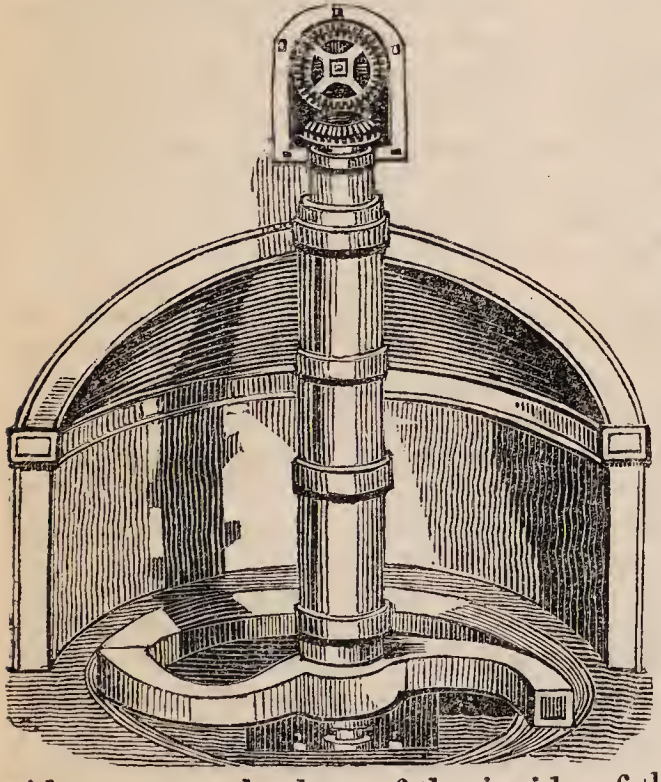
one to the right, the other to the left. This centre-rod or screw moves in the screw-nuts to which the cross-pieces are attached. This is the whole instrument. The screw or centre-pin has a brass head wrought on it at one end ; and when this is turned, the screw, acting different ways at the same time, draws the cross pieces, or bars, towards, and brings the flat side pieces, or frames into closer contact.

The mode of use is, to secure the instrument within the loose back of a portfolio ; place the prints or drawings, or sheets of paper, between the edges of the side frames or flat pieces, turn the screw, and tighten the instrument in proportion to the quantity of paper it is to secure. When any sheet is wanted, turn the screw the other way, and the instrument relaxes, allowing free access to each individual sheet.

The patentee claims the application of such instrument to such purpose, whatever be the material of which it is made, and including all the mode or modes, method or methods of which the application is capable.*

SUGGESTED IMPROVEMENTS IN THE CONSTRUCTION OF BARKER'S MILL.

THE accompanying engravings represent an admirable improvement in Barker's mill,—the suggestion of Mr. James Whiteland, a contributer to the *Journal of the Franklin Institute.* The following description from Mr. Whiteland's own pen, is extracted from the above able work.

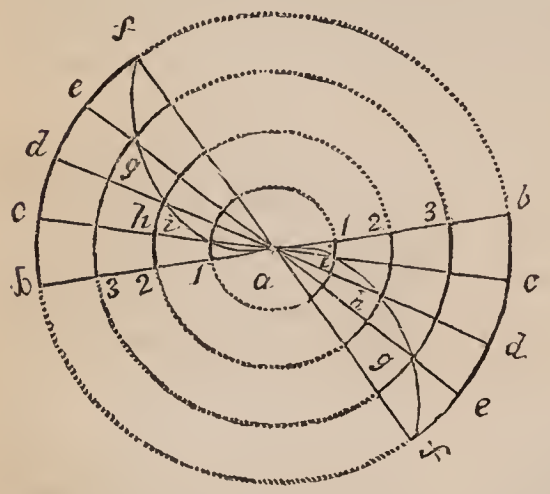


The mill is represented as working a little off the wall of a building. At the top of the drawing, and behind the bevel-wheels, a cast-iron wall plate is shown, for fixing the pillow block into which the horizontal shaft (for working machinery inside of buildings, on which the upper bevel-wheel is fastened) turns. On the under side of this plate a cast-iron trough for conveying water into the mill is fixed ; the trough terminates in a cylinder just so small in diameter outside as to work clear of the inside of the upright cylinders of the

* Repertory of Arts.

mill. This cylinder is so long, and the holes at bottom are so shaped, as to admit the water with the velocity, and in the direction of the water in the upright cylinder of the mill. Inside of the trough-cylinder is a smaller cylinder, through which the upright shaft works: at the top is a larger part for holding brasses for steadying the shaft. Under the trough-cylinder is the cylinder of the mill, made of wood, and hooped, as shown. At the bottom of this cylinder the arms of the mill are fixed; they are of a curved form. Behind the mill is a niche for the arms to work in. At the botom of the niche is a circular trough higher round its outer edge to receive the water after it has escaped from the mill: it is shown by the two ellipses at the bottom of the drawing. Below the mill is seen a square pit, for holding the step, into which the foot of the upright shaft works. The other parts of the drawing will be so easily understood as to make further description unnecessary.

The curved form of the arms is what constitutes the difference of this and Dr. Barker's plan of the mill. The curve is such, that the water will run from the centre to the extremity of the arms in a straight line when the machine is working: by this arrangement no centrifugal force is given to the water, as it has not received any rotatory motion from the arms, which it would have had the arms been straight.



The nature of the curve F, G, H, I, A, of the arms, will be understood by the annexed diagram. Let A be the centre, and A B the distance to the centre of the upper stone from which the water flows; also let the concentric circles 1, 2, 3, divide this distance into equal parts; and take B F equal to the distance that the extremity of the arms would pass in the time that a particle of water would flow from the centre A to B, the extremity of the arms. Divide B F into the same number of equal parts that the distance A B is divided, and from these points let the lines CA, DA, EA, be drawn to the centre. Now, since the motion of the water is uniform, and the motion of the arms uniform also, while the arms revolve from F to E, a particle of water leaving the centre at the time the arms were at F, shall have passed from A to 1; and the points I and 1 will coincide; also when the arms move from F to D, the water shall have passed from A to H, and the points H and 2 will coincide; and so for the other points. When the water arrives at 4, the point G in the arms will coincide with 3; and when the particle moves to the point B, the arms will have passed also to the same point, and F and B will coincide.

Since by this arrangement there is no additional motion given to the effluent water by centrifugal or any other force, till the velocity of the extremity of the arms becomes greater than the velocity of the water, all

that we have to consider in estimating the power of this machine, when working at any velocity less than that of the water, is the effect that a quantity of water, having the velocity that a body would acquire in falling from the top of the mill to the level of the jet-holes, would produce, when working at different velocities.

The weight that will stop the mill must be equal to the weight of a column of water twice the height of the water in the mill, on a base the sum of the areas of the pit-holes. For it is evident that if the holes be shut up, there will be a pressure on all sides equal to the weight of the column in the mill; let, now, the holes be opened, the pressure on the opposite side will remain as formerly, and the water being set in motion by an equal pressure, the re-action (since action and re-action are equal and contrary) will give another pressure equal to the former one, on the sides opposite the holes. Therefore these two forces will give a pressure equal to the weight of a column of water twice the height of the water in the mill, on a base equal in area to the sum of the areas of the pit-holes.

When the mill is working at the velocity of the water, it will raise a weight equal to the weight of a column of water, the same height as the water in the mill, on a base the sum of the areas of pit-holes; and the effect will be a maximum, and equal to the whole power of the water. For it is evident, that as the water flows with the same velocity as it did before, the force of reaction will remain as great as ever, and will just balance the above weight or one half of the weight that will stop the mill. And the other force being caused by the pressure of the water on the areas opposite the holes, must cease when it has brought the velocity of the mill up to the velocity of the water, as this is as quick as the water can follow it. Therefore, with two forces, one to balance a weight equal to the pressure on the areas opposite to the holes, and the other to keep this weight in motion at the velocity of the water, an effect equal to the whole power of the water will be produced. For in the time that the water flows with the velocity that it left the mill, a length equal to the height of water in the mill, this quantity of water, or an equivalent weight, can be raised to the top of the mill.

The effect for the other velocities may be determined in the same way. When the velocity of the mill becomes greater than the velocity of the water, if there is no centrifugal force, the weight that the mill will work with must be the force of re-action, minus the force required to carry the water round with the mill.

If the above theory be correct, we need say nothing of the advantages that this form of the machine has over the other forms, as, indeed, over every other water mill. By considering how much power remains in the water after it has escaped from the mill, when working at different velocities, the same results may be obtained; an additional proof of the correctness of the above theory: thus when the mill is standing the water escapes with its whole force, and no effect is produced. When working at the velocity of the water, the mill moves as quickly as the water, and the water, after it has escaped, has no motion in any direction, but falls directly down. Now, since there is no power remaining in the water, its whole power must be spent in producing an effect equal to its power in keeping the mill and resistance in motion. The power, when the mill is working at one half, or any other velocity, may be determined in the same way. As the motion of the mill is just as quick as that of the water, the portion of the circumference B F must be taken equal to the length of the radius or arms, if the areas of the holes and arms be alike: if the

holes be smaller than the arms, the portion B F must be longer in the same proportion as the water moves slower along the radius.

A rotary steam engine might be made in this way by sending steam through a mill working inside of a condenser. The steam pipe might be connected to the steam wheel by a metallic packing. If the wheel were large in diameter, there would be very little friction, as it would require a so small a pipe in proportion to the power of the engine. The power might be taken from the steam wheel, and the motion reduced by letting the axis of the wheel rest on friction-rollers, and the power taken off the axis of the rollers by means of toothed wheels or other rollers. Another method would be to force water or any other liquid through a machine of this sort by steam.

WEAVING.

Mr. Richard Whytock, of Edinburgh, has patented an improved method or manufacture which facilitates the production of regular figures or patterns on different fabrics, particularly velvet, velvet pile; and Brussels, Wilton, or Turkey carpets.

The object the patentee has in view is to prevent waste, and to make the common loom applicable to all the purposes of what is called the figure loom.—Instead, therefore, of using a variety of different coloured yarns, either in the warp or woof of his velvet or carpet manufacture for the looping in the Wilton carpets, and for the knotting in the Turkey carpets, he uses but one yarn, all coloured at the same time, and by a process of some novelty.

He provides himself with a huge tumbril or cylinder, revolving on a horizontal axis like the common grind-stone; (this is the patentee's own simile) at the extremity of the axis is fastened a pulley, which corresponds with another pulley, secured to the wooden frame that supports the cylinder. These are connected by an endless strap; and to the pulley in the frame is attached a regulating, or directing screw, the motion of which is simultaneous with that of the cylinder.

To the foot of the frame, and rising to the level of the outer disk of the cylinder, is a rack containing spindles, on which are placed reels of yarn, of the quality of which the carpet is to be composed, or for any other fabric. If the ground of the subject is to be white, the yarn on these reels is white; if of any other colour, the yarn is dyed of that colour before it is wove on these reels. The cylinder is covered with a blanket, and then with an oil cloth, and the yarn for each spindle is drawn through loop-holes of wire in the rack, and through eyes in the directing screw, or regulator; thence they are led to the cylinder, and carefully attached to the oil skin; the cylinder is then turned slowly and carefully until the yarn is wound on its whole surface, in such-wise that the threads shall lie as regular as possible, not touching each other and yet "only not" touching; as close almost as contact.

When the cylinder is quite filled with the yarn, the ends are

again carefully fastened to the oil cloth, and colours are laid on by means of rulers, or spars buffed with felt, as used by the figure workers or block printers. The felt surfaces of these rules are dipt in the colour sieve, as is well known to the operators, and it is laid on the yarn, as wove on the cylinder, at regulated distances and in exact proportions.

These proportions are to be ascertained only by a pattern paper, divided into squares, say 74 at top, and 104 down the side. On the paper thus squared out, is drawn the pattern; and the yarn on the cylinder, being the perpendicular lines, the transverse horizontal lines are marked down the side of the cylinder, as a kind of key. The operator then carefully observes how many squares of his pattern are left blank, and these he leaves so. He then counts the number of squares in the first line that are to receive a colour, say light blue, and he then applies his ruler with the felt edge dipped in the colour, and so colours the yarn at once. When he has done this he turns the cylinder until the next numbers that require the colour are uppermost, and he again applies his felt ruler, and so on until the pattern is completed. The yarn is then taken off the cylinder on the oil cloth, which is removed at the same time, and when the colour has dried, the yarn is washed, and is afterwards exposed to the process of steam dyeing, according to the usual method. When all the yarn is thus prepared, it is beamed for the loom, and the woof is ready. The warp is prepared to correspond, and the whole process of carpet making, or of velvet weaving, proceeds in the common loom without the laborious manipulations, the waste, and the delay of the figure loom.

There is much of the process old, great part of it new, and the modification is altogether so. The patentee claims merely the means by which the common loom may be made to produce all the effects of the figure loom, particularly the cylinder, the colouring, and the directing rack.*

CANAL OF GOTHA.

One of the greatest undertakings of Europe has been completed, after a labour of twenty years—we mean the canal of Gotha, which traverses Sweden in all its breadth, from Gottenburg on the Cattegat to Soderkoping, on the Baltic. This great and useful work has been executed at an expense of 10,000,000 of rix dollars. In joining the two seas, the canal of Gotha opens to trade a far shorter and safer passage to the Baltic than that of the Sound, which obliges vessels to double the southern coast of Sweden. By the canal, on the other hand, the navigation is all inland, and therefore more commodious and secure. The duties too are much less than by the Sound; generally less than one-half. The trade to Russia and Northern Prussia may infallibly

* Repertory of Arts.

be expected to pursue this route, as soon as its advantages are known and appreciated.*

MANUFACTURE OF OAKUM FROM JUNK.

Mr. E. Cook, of Haddam, Connecticut, has invented a mode of softening the junk from which oakum is to be manufactured, which is very superior to that heretofore followed, which consists in allowing it to stand for a considerable length of time in kettles containing hot water; that in the new process the water into which the junk is thrown is put into rapid motion, whereby the fibres of the junk are so far separated as to render the picking easy, and, at the same time, the oakum is of a very superior quality. The machinery ordinarily used by him consists of a cistern, or vat, resembling the vat of the beating machine used in paper making. In the place of the revolving cutters, or beaters, there is a paddle wheel, the revolution of which keeps the water and junk placed in the vat in constant motion. A furnace is so fixed at one end as to keep the water constantly heated, and the whole is covered to prevent evaporation. The claim is to the method or principle of making oakum, and preparing the junk for that purpose by keeping it in motion or circulation in hot water, in the manner hereinbefore described, or by different machinery, or in any other manner.†

PORTABLE OVENS.

Mr. William Goddard, Portsmouth, Rockingham County, New Hampshire, has patented a new portable oven for roasting and baking.

This oven is formed of three separate sheets of iron or tin, and is in the form of a segment of a cylinder: in making it, sheet metal of suitable dimensions is bent round so as to form about three-fourths of a circle, the edges are then joined by a flat piece, which forms the bottom of the outer case. A second piece of sheet metal is then bent into the same form, but is to be the segment of a smaller circle than the first, so that when slipped into it, there will be the space of an inch between them; this when in its place, is to be rivetted to the bottom of the outer case. A plate is to be put on at the back end, and a rim fixed, inclosing the space between the two at the front. The space may be filled with charcoal, or other bad conductor, or may be occupied by air only. Through both these vessels two holes for flues are to be made at the top, one near to each end, and these are to lead to one common pipe, furnished with a damper; another hole is to be made for the escape of steam. Heat is to be applied by a round stove, or furnace, under the middle of the oven, a hole being perforated through the bottom sufficiently large in diameter

* Times.

† Quoted from the Franklin Journal, in the Mechanics' Magazine.

to receive it; and a ring of cast, or of wrought iron is rivetted to the bottom, in order to give the requisite strength to this opening.

A third box, made in the form of the other two, constitutes the oven proper. This is made exactly in the form of those already described, and is to be slipped into its place within them, leaving a space between it and the second box, and also between its back end and the first, which space is for the passage of smoke and heated air from the fire, around the oven, to the flues. The bottom of this is exposed to the action of the fire in consequence of the perforation made through the outer box. When this last is secured in its place a door is to be fitted to it in the usual way.

Their is no claim made to any part of this apparatus; the security of the patent, therefore, must depend upon the general novelty of its construction.*

CANAL STEAMER.

A SMALL steamer, called La Reine, built at Manchester, conveyed to Belgium, being intended to ply with goods and passengers on the grand canal between Ostend, Bruges, and Ghent, instead of the truckschuyts or boats drawn by horses, hitherto employed in the communication between those cities. The engine is on the high pressure principle. Her hull is entirely of iron, with one paddle-wheel fixed in an opening of the stern, so that her engine-room and boilers are abaft the principle cabins. This has been so fixed to prevent the agitation occasioned by the wheel injuring the banks of canals. She is steered by two rudders, one on each side the paddle wheel, but both managed by a single wheel upon deck; and we understand that upon her passage from Liverpool to Milford she averaged seven miles an hour, in spite of the cross seas of the Irish channel; of course, in the smooth water of the Belgic canals her speed will be considerably greater.†

AMERICAN IMPROVED CLOCK.

THIS improved clock is not destined to take the place of chronometers, or of time-keepers made for astronomical purposes; we believe, however, that it possesses novelty, and compared with clocks in general, it has great simplicity. A piece of board 6 inches square forms the foundation of the clock, and this it is proposed to hang on a nail in a wall, by a ring placed at one of its angles. Into the centre of this board a round steel pin is driven, which receives the pipe or barrel of a fling wheel, the diameter of which is nearly equal to that of the board. Just above the teeth of the fling wheel, another piece of steel is driven, which forms a knife edge suspension for the pendulum. This latter is a long bar, say of two feet, weighted at each end, and hung in a horizontal position upon the knife edge, like a scale beam; a part of the pendulum, on each side of the point of suspension, extends downwards,

* Franklin Journal, in the Repertory of Arts.

† United Service Journal.

so as to form pallets acting on the teeth of the fling wheel, and thus constituting the escapement. The face upon which the hours and minutes are marked, is a flat circular rim, which is merely hung upon the point of the swing wheel, and is furnished with teeth or notches, which must, we suppose, fall into corresponding teeth on the outside of the pipe, although we are not so informed in the specification. A second but smaller circular rim is also hung upon the same pipe, and has a projecting part upon it, which constitutes the hour-hand. The size of the openings, and the number of the notches, on these suspended rims, must be so calculated as to correspond with the other parts of the machinery. A weight, acting on the pipe or barrel of the fling wheel, is the maintaining power. A fixed wire, extending from the centre pin to the knife edge, serves the purpose of a minute hand, as the suspended rim revolves beneath it.*

NEW PRINTING MACHINE.

A SMALL printing machine, on an entirely new principal, invented by Mr. J. Bogle, of Perth. In rapidity of action it is equal to Cowper's machine, and so easily worked that a boy may drive it with one hand. One person can work it, but more may be employed with equal facility, according to the hurry of the job. The machinery is constructed in such a way as to distribute the ink on the rollers, take in the sheet, print it, and deliver it at one and the same instant of time. It is perfectly at the command of the workmen, and keeps a record of the work it executes; so that the workmen is saved even the trouble of counting his paper. This machine has not a single wheel about it; the contrivance for taking in and delivering the sheets is very ingenious—the only mystery being that such correct results are produced by so simple and apparently inadequate means. It prints every variety of work with the utmost facility; produces a clear and beautiful impression of a uniform colour, and altogether equal to any thing that can be done by any other press; prints correct register, requires no slip or blotting sheets, and in long numbers the impression, is as clean in the last sheet as in the first. It also possesses the recommendation of working silently, and occupying less room than a common press, while it is much more cleanly.

In a run of similar work, the forms can be adjusted on the machine in one minute, and in every case the types are as easily adjusted, and as readily got at in case of alterations, as on the common press. Although there is a great deal of brass and iron work in the construction of the machine, the inventer, who is a joiner, has executed every part of it himself,—a task, the difficulty of which can only be known to those who are aware of the correct machinery required in printing.†

* Mr. J. S. Seger, New York, in the Franklin Journal, quoted in the Mechanics' Magazine.

† Perth Advertiser.

SEPARATION OF MAGNETIC ORES.

Mr. Goulding, of Reesville, New York, has patented a machine to employ magnets in separating the available ore from the extraneous matter, with which it is mixed. To effect this the ore must be pulverized before passing it through the machine. It will at once be perceived that the apparatus spoken of cannot be applied to them indiscriminately, but to those only which are denominated magnetic. There is much iron ore, of excellent quality, which does not possess this property; and sometimes these and the magnetic ores are to be found in the same mine. In either of these cases the machine to be described cannot be usefully applied. A hollow cylinder is to be made, which, in the machine refered to in the specification, was about four feet long, and two feet eight inches in diameter. This cylinder has no gudgeons, but its periphery rests upon those of two cylindrical rollers, and motion being given to these the cylinder is also turned. It is lined throughout with short magnets, confined in their places by means described in the specification. The cylinder is a little inclined, like a bolting screen, and the pulverized ore being introduced at the elevated end, the refuse matter escapes at the other. In its passage, the magnetic ore adheres to the magnets, and from these it is swept off by a revolving brush, into a trough passing through the cylinder.*

THE PERCUSSION LOCK.

The French government have given an order for the fitting up of two thousand muskets with percussion locks, in order that their efficacy may be ascertained by actual use in the ranks, an experiment made with them in Hanover, in April last when every regiment in the service was supplied with forty muskets fitted with these locks. Various trials were subsequently set on foot in wet weather, and with the customary description of cartridges; and the result was, that, on the discharge of 27,000 cartridges from 340 percussion muskets, the cap missed fire one and twenty times, and the loading failed to ignite in seventy-two instances after the cap had ignited. In the same 27,000 primings and loadings with the common musket, the priming missed 1,448 times, and the loading failed to go off in 378 instances after the priming had exploded. A fresh series of trials were afterwards made, the muskets being discharged in repeated succession without any cleaning; during these trials, twenty-two caps failed to take effect, and out of 14,000 loadings only fourteen missed fire; on the other hand, out of as many loadings with common muskets and flints, the failures amounted to 306. Experiments were next made with percussion guns which were exposed to a heavy shower of rain, the caps being wetted, and a drop of water being

* Franklin Journal, in the Mechanics' Magazine.

let into the touch-hole; and was found that, even under such unfavourable circumstances as these, the percussion lock remained incontestably the most efficient. Similar experiments have been instituted by the Belgian government.*

PRESERVATION OF COPPER.

Mr. Jacob Perkins has patented an improvement in preserving copper, in certain cases which he describes as follows:—

My invention relates to the preservation of the copper tubes used in steam-boilers, particularly such as are now employed on the Manchester and Liverpool rail-roads. In which boilers the flues from the fire-box or furnace consists of a number of small copper tubes through which the heat, fumes, and vapours pass to the chimney, and it has been found that these tubes become quickly destroyed by oxydation. Now my improvement consists in coating the parts of such copper tubes, directly acted on by the heat, with an alloy, or mixture of copper and zinc, by which means such copper tubes will be greatly preserved from the effects of oxydation produced by heat.

But in order that my invention may be most fully understood and carried into effect, I will describe the means I have pursued in coating tubes, either on the outer or inner side thereof; for although I have particularly mentioned the tubes used in boilers similar to those employed on the Manchester and Liverpool rail-roads, in which case the inner surface of the tubes is the part subject to the action of the heat and vapours arising from the fire-box or furnace, yet the same effect will be produced in coating tubes on their outer surfaces where they are used in boilers, and have the water on the inside and the fire acting on the outer surfaces. I mix about *two thirds* of copper with about *one-third* of zinc, by melting (these being the proportions I prefer,) but I do not confine myself thereto, as the same may be varied. With this mixture I coat the surfaces which are to be directly acted on by the heat and vapours, by bringing the surface, whether the exterior or interior surface so to be coated, in contact with a quantity of the melted alloy aforesaid, and keeping them in contact till the melted metals or alloy adhere all over those surfaces of the copper tubes which are to be directly acted on by the heat; or I effect this coating in a similar manner as is practised in joining the two edges of the copper in making the copper tubes, taking especial care that there is a thin coating over every part of that surface of the tube which is to be directly acted on by the heat.

Having now described the nature of my invention, and the manner of performing the same, I would have it understood, that what I claim as my invention, is, the coating copper tubes in steam-boilers with a mixture or an alloy of copper and zinc, as

* United Service Journal.

above described, and thus greatly preserving them from oxydation caused by heat.*

PAPER MAKING.

Mr. John Ames, Springfield, Massachusetts, has patented an improvement in the method of sizing paper by machinery which he specifies as follows:

I, the said John Ames, have invented, made, and applied to use, a new and useful invention and improvement in the method and process of sizing paper by machinery, as is herein set forth and specified, viz., upon a frame of proper strength and materials, I place near, and parrellel to each other, three cylinders of wood or metal, of about fifteen or twenty inches in diameter, and in length conforming to the width of the paper to be sized, to revolve in a horizontal position upon their respective axis. The boxes or bearings upon which the axis of one of the said cylinders rests, are fixed; those of the other two are movable, and governed by screws, so as to regulate the distances of the cylinders from each other. Above the line, between the middle cylinder and one of the outer ones, and parrellel to them, I suspend a pipe or trough, pierced with small holes, in such a position, that the sizing matter with which the said trough or pipe is to be filled, may drop between the said two cylinders. Below the said cylinders, three parrellel rollers, corresponding in length with the said cylinders, are arranged so that the middle roller shall be elevated a little above the line of the other two. Above the middle roller I suspend another pipe or trough, as above described, to be also filled with sizing matter. An endless web of felt is made to pass over one of the outer cylinders, and between it and the middle one, thence down under the middle roller; thence up between the middle cylinder and the other outer one; thence over the latter and down under the two lowest rollers; and thence up to the place of beginning. The cylinders are to be brought in close contact by means of the screws applied to the said movable boxes or bearings. The paper to be sized is brought over the outer cylinder and introduced between it and the middle one immediately under the sizing trough or pipe from which the sizing matter drops and sufficiently wets one side; it then passes under the middle cylinder, to which it adheres: the felt passes down under the middle roller, and is wetted by the sizing matter oozing from the lower sizing trough or pipe; and again ascending, it passes between the other outer cylinder and the middle one, pressing the paper against the latter, and thus sufficiently sizing the other side of the paper. The sized paper is to be then disengaged from the middle cylinder (to which it adheres as aforesaid) and taken off by a cylindrical or other suitable reel.

* Repertory of Arts.

The moving power is applied to the middle cylinder, which communicates motion, by friction, to the other parts of the machine connected by the endless felt. The same result may be produced by a different position and arrangement of parts. I do not claim the cylinders, endless felt web, or other parts of the machine, separately, as my invention; all that I claim specifically as mine, is, the several parts of the said machine in combination, with the use of the endless felt web, for the purpose of sizing paper.*

AMERICAN STEAM BOATS.

(*Abridged from a Paper, by Mr. Redfield, in Silliman's Journal.*)

In addition to twelve steam-boats which are employed on the Hudson River in the various lines of transportation, and on short routes, there are ten boats of the first class, which have been employed in daily trips for the conveyance of passengers between New York and Albany, viz. the North America, Albany, Novelty, Erie, Champlain, Ohio, New Philadelphia, De Wit Clinton, Constitution, and Constellation.

Most of these boats have undergone a material change in their size, form, and general outfit, since their first construction, in order to maintain a successful competition for the business of this noble river.

The *De Wit Clinton* having been twice enlarged, is now of the following dimensions, viz. entire length on deck 233 feet, breadth of the hull at the water line 28 feet; projection of the deck or wheel-guards on each side, 18 feet; maximum width of deck, including guards, 64 feet; depth of hold 10 feet, height of the upper deck 11 feet; length of the great cabin 175 feet; draft of water, not exceeding 4 feet 6 inches; diameter of the water-wheels 22 feet; length of the same, measured on the buckets, each wheel 15 feet; depth of the bucket or paddles 37 inches; diametar of the iron water-wheel shafts 14 inches; length of the crank 5 feet; length of the stroke made by the piston 10 feet; diameter of the piston 66 inches, its superficies being equal to 3,421 square inches. The gross length of the working cylinder, which is placed in a vertical position, is 11 feet 10 inches; its lateral aperture, by which the steam is received and discharged, are 42 by 10 and three-quarters inches. The engine is worked by means of four circular receiving valves, each of 17 inches diameter (two at either end of the cylinder), and four exhausting valves of the same dimensions. The diameter of the main steam-pipe and side pipes is 25 inches.

The entire capacity of the cylinder, deducting the space occupied by the piston, and including one of the side apertures ex-

* Journal of the Franklin Institute.

tending to the valves is equal to 252 cubic feet, which is equal to 1,890 standard wine gallons, or sixty three barrels of thirty gallons each. Should the engine perform twenty-six revolutions or double strokes per minute,* there will be exhausted 13,104 cubic feet = 3,276 barrels per minute, and 786,240 cubic feet of steam, or 196,560 barrels will be exhausted every hour, during the time in which the engine is in full motion! But the steam is allowed to enter freely from the boiler, only during a part of each stroke, the throttle-valve being then closed, and the steam which has previously entered the cylinder is allowed to expand during the remainder of the stroke. If the pressure of steam maintained in the boilers be equal to twenty pounds per square inch above the mean pressure of the atmosphere (and greater pressure is frequently employed in these boats), the average effective pressure on the piston may be safely estimated, even with less pressure, at about ten pounds for each square inch of its superficies. To this must be added the *net* pressure of the atmosphere, obtained by the use of the condenser and air-pump, which is fully equal to ten pounds to the inch, the vacuum in the condenser varying generally from twelve and a half to thirteeen and a half pounds to the inch, by the barometrical gauge. This estimate, which is obtained by near approximations, will give an average pressure on the piston equal to twenty pounds to the square inch; but, lest we should be charged with overrating, we will reduce it to sixteen pounds effective pressure to the square inch, or 3,421 inches of piston, running fifty-two single strokes of ten feet each per minute. Estimating now the full powers of a horse as equal to 150 pounds, moving at two and a half miles an hour, or to raising 33,000 pounds one foot per minute, we have the following formula:

$$\frac{3421 \times 16 \times 52 \times 10}{3,3000} = \frac{28462720}{33,000} = 862$$

showing a force exerted upon the engine which is equal to the power of eight hundred and sixty-two horses. From this result we are to deduct the power necessary for moving the engine, or that required for overcoming the friction and resistance of its parts, which is comparatively less in engines of this magnitude, working on such an extended crank, than in the average of smaller engines. We will estimate it, however, as equal to one-third of the force applied, which gives the effective working-power of the engine as equal to that of five hundred and seventy-five horses. An engineer, under whose direction several of the engines in these boats have been constructed, estimates the net

* The engines of some of the Hudson River boats are often seen running at the rate of twenty-eight double strokes per minute, the velocity of the piston being 560 feet per minute.

effective pressure, *exclusive of all deduction for friction*, &c. as equal to twelve pounds for every square inch of the piston. This may be nearer the truth, and gives the working-power of this engine as equal to six hundred and forty-six horses. Such results may at first view appear to be of a startling character, even to professional readers, but having been arrived at by gradual approximations, they seem hardly to have attracted the attention, either of men of science or practical engineers.

The following may be given as a summary statement of the principal dimensions of the other boats which have been named, and which, if not minutely correct in all its particulars, is sufficiently so for purposes of general information. The Champlain, a new boat, is 180 feet in length, 28 feet beam on the water line, and has two engines of 42 inches cylinder, and 10 feet stroke, which, with wheels of 22 feet, run from 26 to 28 revolutions per minute. The Erie, also a new boat, is of the same size, and somewhat greater power, her cylinders being of 44 inches diameter.* The North America is 218 feet in length, including a cut-water bow (which has also been affixed to most of the other boats), 30 feet beam, and has also two engines, with cylinders of 44 inches diameter, and 8 feet stroke. The Albany is 207 feet in length, 26 feet beam, and has one engine of 65 inches cylinder, and 9 feet stroke. The Ohio is 192 feet in length, 30 feet beam, and has one engine, with cylinder of 60 inches diameter, and 9 feet stroke. The New Philadelphia is 170 feet in length, 24 in breadth, and carries one engine of 55 inches cylinder, and 10 feet stroke. The Constitution is 145 feet in length, 27 feet beam, and has one engine of 42 inch cylinder, and 9 feet stroke. The Constellation is about 149 feet in length, 27 feet beam, and carries one engine of 44 inches cylinder, and 10 feet stroke. The Novelty is about 220 feet in length, 25 feet beam, and has two engines, with cylinders of 30 inches in diameter, and 6 feet stroke, working horizontally, using steam of higher elasticity, and dispensing also with the use of a condenser and air-pump. Most of the above steamboats carry their boilers on the wheel-guards, entirely without the body of the boat. The Erie and Champlain carry each four boilers, and the same number of chimney pipes. The Novelty has four sets of boilers, of about forty inches in diameter, three in each set, and carries also four chimneys.

PREVENTION OF DRY-ROT.

At a late meeting of the Royal Institution, after adverting to the extensive decay of wood in ships, houses, and other structures of that material, involving a loss of such magnitude, as to have excited almost universal search after a remedy, Mr. Faraday said he should pass by all propositions for its prevention, except

* These two boats run to the City of Troy, a prosperous and beautiful town situated six miles above Albany.

that one absolutely introduced by Mr. Kyan, and to which Mr. Faraday had paid particular attention. The process is now largely in use. The wood, prior to its application, is immersed in a solution of corrosive sublimate; in the course of a week, a load of it is found to have absorbed five gallons of solution; at the end of that time it is removed, and shortly after becomes fit for building. The preservative powers of corrosive sublimate in furs, stuffed birds, anatomical specimens, &c. are well known; and those which it exerts over wood seem to be not less decisive, and far more useful. Pieces of timber thus prepared were put into a fungus-pit at Woolwich for three years, and at the end of that time taken out perfectly sound. Canvass and calico, treated in a similar manner, were also found to be preserved from mildew and decay. Mr. Faraday's suspicions appear to have been excited, not so much as regarded the preservative power of the process, but the healthiness of the wood, canvass, &c. impregnated by it; and he required that such prepared materials should be thoroughly washed, and then submitted to a test for proving the power of resisting decay. He found, after calico and canvass had been washed in water until all the solution which that fluid could remove had disappeared (mercury was still present), such *prepared* materials were preserved in a damp cellar, while the *unprepared* went rapidly to decay. Having ascertained this combined state of the mercurial preparation, Mr. Faraday expressed his opinion, that the organic substances could be well preserved by it without deriving any unwholesome quality to deteriorate their ordinary application.*

RAISING WATER.

Mr. Edward Lucas, of Edmond Street, Birmingham, has patented for a self-acting force and lift pump for raising water. The object of his invention is to take advantage of any small yet constant running streams of water, which being received into boxes or receivers, are caused by their weight to produce the necessary power for working the pistons of ordinary force and lift pumps. The drawing attached to the specification represents two working cylinders, with the usual suction pipes, valves, &c. The piston rods are attached to levers or handles similar to hand pumps, these levers having proper bearings, and at their opposite ends are attached boxes to receive the water from a cistern which is kept supplied by a stream of water. It will be readily understood that the water boxes become alternately filled with water, descend by their weight, and thus raise the pistons, and by this action the water flows from the well or other reservoir into the cylinders of the pumps, and the return stroke of the pistons being caused by weights attached to the piston rods, which come

* Jameson's Journal.

into action when the water boxes descend and discharge the water, by turning on their axis, the boxes being properly balanced to produce this action. By the descent of the piston rods, the water in the cylinders will be forced out through the eduction pipe in any direction, according to the purpose for which the supply of water is desired. The handles or levers of the pumps are supported in the horizontal position by means of short weighted levers, which prevent the water boxes descending till the quantity of water within them is sufficient for raising the weights on the piston rods, and overcoming the friction of the piston. In the cistern which supplies the water boxes, there are affixed spouts having weighted valves or plugs, which are opened by projecting arms attached to the levers or handles of the pumps at the time the water boxes are raised up to be filled; but when the water boxes descend, the projecting arms being carried down by the handles of the pumps, the valves close.

By these additions to the ordinary force and lift pumps, the patentee considers that baths, fountains, buildings, &c. may be supplied with water at a small cost, by the application of the power of a small and otherwise insignificant stream of water.*

CLEGG'S ONE-LIGHT DRY GAS METER.

Gas and water are the only articles of commerce that are not sold by weight or measure. The consequence is that random bargains are made. The gas supplier demands an equivalent for the greatest possible quantity to be supplied, and the gas consumer tries all he can to make the most of his bargain by the length of his flame. The moderate man is forced to pay for the extravagance of his neighbour. Were it otherwise, could the article be bought and sold at a fixed price for a stated consumption, its use would have been, ere now, three times as extensive as it is.

There is no light so pure, so perfect, so safe, so cleanly, if under proper management. Look, for instance, at the shops in Regent Street. The most delicate mechanism, the purest fabrics, the richest materials, and the most splendid colours are nightly liable to the action of the gas, but neither smoke, smell, nor stain ever occur, because the flame is kept below the brim of the glass, and the oxygen passing freely within and around the circular flame, consumes the smoke. Where careless persons allow the flame to rise above the glass, black walls, an annoying sound, and an intolerable smell bear witness against them. The abuse ought not to detract from the use.

The difficulty of measuring gas ought not to be an objection. Water is inaccurate: but Mr. Samuel Clegg, of Sidmouth Street, Regent Square, London, Civil Engineer, has invented, and brought into extensive use an instrument of which the accuracy is

* Repertory of Arts.

only equalled by the beauty. The following account of the invention is given almost in the words of the Inventer :—

Two glass globes, one filled with alcohol, and all air excluded from the other, are joined together by an *S*-shaped pipe, and form an instrument resembling in power *the differential thermometer* of LESSLIE, from which it differs only in shape.

This little instrument indicates with the most remarkable accuracy, the variation of temperature between its globes; so that if a stream of gas, cooler than that in which the instrument is made to revolve, be allowed to flow upon the upper bulb, it causes the spirit in the lower bulb to ascend to the upper one in a time precisely corresponding with that in which the gas continues to discharge itself upon the bulb.

Thus :—Let one-tenth of a cubic foot of gas discharge itself upon the upper bulb in twelve seconds—in twelve seconds the spirit from the lower bulb will have ascended to the upper one. If the same quantity of gas occupy six minutes in discharging itself, six minutes will be occupied by the spirit in passing from the lower to the upper bulb.

If, then, a regular stream of air could, by any simple contrivance, be made to act upon the upper bulb, the instrument would form an excellent *time piece;* we shall proceed to describe the mechanism by which this thermometer is made applicable to the purpose of the most accurate *gas meter.*

The *S* instrument, formed of its globes and connecting pipe, all of glass, is mounted upon an axis, and revolves freely on a bearing near each end. To *one extremity of the axis* is fastened a detend, to each limb of which, and parallel with the axis, a wire is attached: these rest alternately on a catch, and by their means the upper globe is sustained in its place, which is sufficiently out of the centre of gravity to let it fall whenever it is filled from the lower bulb. To the *other extremity of the axis* is fastened a crank which gives motion to a train of wheel work calculated to register the number of revolutions performed by the globes during the space of half a year; or, which is the same thing, the quantity of gas which has passed through the meter in that time.

A very simple and efficacious contrivance for performing two important functions is the junction of a beam and its wire; the one regulates the quantity of gas to be discharged on the upper globe, the other nearly shuts out the supply of gas, should the wire of the detend by any means be knocked off the catch.

The wire is fastened to the beam, which moves upon a centre so adjusted that it overhangs the wire of the detend. Before the detend can pass this wire in its revolution, it must push it sideways, and by that means raise the end of the beam to the right of its centre. If the weight of the beam at this end be greater than at the other end, a resistance is offered to the wire at the end of the detend, and that in proportion to the weight raised; consequently, as that weight varies, so will the quantity of liquor in the upper bulb be more or less to overbalance that weight, of course requiring more or less time to raise the necessary quantity of alcohol into the superior globe, and this time is adjusted to the quantity of gas to be expended.

At the heavy end of the beam is a small circular orifice, and in this beam, running freely, is a ball rather larger than that orifice. The action will be thus: when the wire of the detend is off its catch, the heavy end of the beam will fall until a pipe accompanying it, rests on a pipe beneath. In that situation the heavy end of the beam is the lowest, and the ball

will roll to that end till it falls into the orifice, closing the only communication to the burner. Now these pipes come in contact at every vibration of the globes, the beam, therefore, must be of such length that the ball in its traverse will occupy more time than the detend requires for half a revolution. The detend then will be on its catch before the ball can reach the orifice, and thus the exit for the gas, and its passage to the burner, is preserved.

Thus far the *mechanical* construction of the instrument, now to explain the *philosophy* of its operation.

The burner attached to the meter being lighted, the caloric arising from it will be conducted by its copper frame downwards until the whole is at a temperature sufficient to heat the gas as it flows through the meter, to the degree required. To prevent needless radiation of the heat, the copper frame is inclosed in an air-tight paper case, which is again inclosed in a case of metal, sufficiently close to keep it warm, but so distant as to prevent contact.

The gas to be measured is introduced at the bottom of the meter, and passes along a pipe which terminates over the centre of the upper bulb. The length of this tube is such, that in passing through it the gas acquires a temperature always a little below that of the interior of the meter, the gas then passes to another pipe, and is conducted to the burner.

The interior of the meter being heated as described, and the gas flowing upon the upper bulb at a temperature less than that which surrounds the lower bulb, the vapour from the alcohol in the upper bulb will be condensed whilst the vapour from the spirit in the lower bulb is rarified, until the liquor in the inferior is forced into the upper orb, which becomes heavier by its acquisition, and descends, the now empty bulb at the bottom taking its place. This operation will go on as long as the lamp remains lighted, and the rapidity of the revolution will be in exact proportion to the height of the flame, thus measuring accurately the quantity of gas consumed.

Between the globes is placed a piece of pasteboard to prevent the gas from flowing from the upper globe to that beneath, but it has a better purpose. A little pipe with a cap on, is so fixed as to act on this pasteboard. Should the detend get off its catch the cap may be removed, and by blowing strongly through the pipe, the breath will force the pasteboard to descend, and so regulate the detend, by restoring it to its catch; the gas will then have a free communication to the burner, and the operation will proceed as before.

The average time required before the meter "clicks" after the burner is lighted, is twenty minutes: in winter it will be more, in summer less, so as to preserve the equilibrium on the whole year. The loss amounts to 20 per cent., and therefore the meter, when in action, is made to register 10 per cent. more than the actual quantity of gas which passes through it, so that the balance is accurately preserved.*

IMPROVEMENT IN MEDAL RULING.

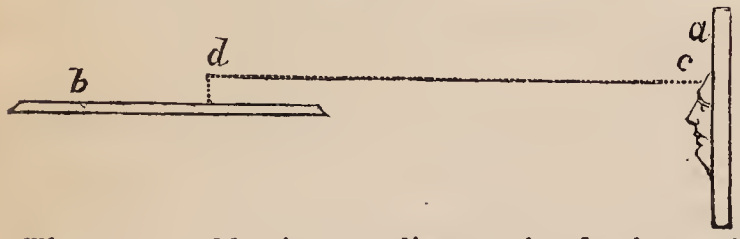
This ingenious process is thus described by the inventer, R. B. Bate, Esq. in a letter to Sir David Brewster:—

About fifteen months ago, some printed representatious of medals

* Repertory of Arts.

received from America were shown to me, with an inquiry into the manner in which they were produced : it was evident that they were the result of a ruling process ; and one of my sons, having been engaged in ruling micrometer divisions, constructed an apparatus for performing this process, upon a scale sufficiently large for medals, and obtained the *same* results.

The following diagram represents the construction of the apparatus.



a. Being the medal. *b*. The plate, covered with an etching-ground. *c*. The tracer; and *d*, The etching-point, at right angles to it.

The arm *c*, *d* having a ruling motion horizontally across the surfaces of *a* and *b*, and likewise moving freely in the direction *c*, *d* ; also, vertical motion being given to *a*, and horizontal motion to *b* by the same screw ; a series of lines traced over the medal were described upon the plate in the following manner : so long as the tracer moved over the plane surface or ground of the medal, the point *d* described equidistant lines upon the plate ; but so soon as the tracer touched a part of the raised surface or relief of the medal, it was raised above its plane a quantity equal to the height of such relief, and the line described by the etching-point was no longer equidistant, but deviated an eqnal quantity upon the horizontal plate ; in the succeeding line, the tracer being raised off still further by the increasing height of the relief, the etching-point deviated still further from the former line described upon the plate : the continuation of this process produced a succession of deviating lines upon the plate, which, opening as the tracer rose above the plane of the medal and closing again as it approached that plane, gave the effect of light and shade, in the printed impression of the plate, so perfectly as, contrasted with the even tint produced by the parallel lines representing the plane surface of the medal, to convey to the mind almost a conviction that the impression was raised above the level of the paper.

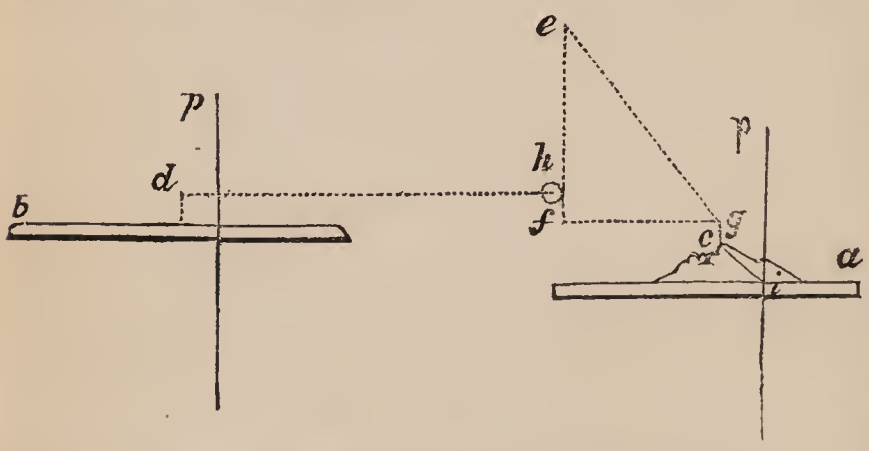
However pleasing the effect of these impressions, they were all distorted representations of the original (just so much as the lines producing the representation deviated from the straight line upon the medal) ; and having ascertained that this method of producing such representations had been known to engravers upwards of fourteen years, as likewise that an account of it was given in a French work, called the "*Manuel de Tournure*," it became evident that this distortion had suspended the use of the process ; the most valuable and interesting subjects, those possessing the highest relief, being the most distorted.

It appeared to me, as it had no doubt appeared to others, that this defect was irremediable, because the distortion arose from the principle upon which the process was conducted ; and although the quantity of distortion might be diminished by diminishing the motion of the etching-point, yet as this would reduce the effect of the relief, it would impoverish the effect of light and shade accordingly.

My son, however, whilst engaged in the process of ruling the large Napoleon medal, which required the application of three whole days, observing that the thing to be desired was a means of bringing the tracer down upon the medal, a quantity equal to the deviation of the etching-point from the straight line upon the plate ; observing also that the process he was employing transfered vertical sections of the medal to the

plate,—proposed taking *inclined* sections of the medal: a little consideration determined the selection of 45°, as being equidistant from the vertical and horizontal positions employed, and this inclination completely fulfilled the purposes required, removing the distortion altogether, and, so far from impoverishing the effect of light and shade, improving that effect, inasmuch as, without diminishing its quantity, it threw the light upon the representation of the medal at the angle of 45° to its plane, instead of, as before, in the direction of the plane of the medal.

It was, however, soon found necessary to restore the tracing-point itself to the vertical position with respect to the plane of the medal, to allow of its being brought into every part of the surface which it had to rule, and, for the same reason, the mechanism which gave motion to it was obliged to be removed and the hand to be employed in its stead; the arrangement then became similar to the following diagram:



The tracer *c* being now attached to the right angled triangle *e*, *f*, *g* and a friction-roller substituted for it at *h*, the triangle (the motion of which was *strictly confined to the plane of the diagonal e, g*) moved *d* a quantity always equal to the distance of the tracer *c* from the perpendicular *p*; so that the etching-point described precisely the same line upon the plate *b* as the tracer described upon the surface of the medal *a*, in the following manner:—so long as the tracer moved upon the plane surface of the medal, equidistant and parallel lines were described upon the plate, as before; but the moment the tracer rose above the plane surface of the medal, it began to deviate from the perpendicular *p*, and continuing to rise, described the diagonal *i*, *c*, parallel with *g*, *e*; now *e*, *f*, being always parallel with *p*, the deviation from *p* was always equal, as well upon the plate as upon the medal.

This improvement being, as I have no doubt you will immediately perceive, at once efficient and correct, I have procured my son a patent for it; and he is now constructing an apparatus for performing the process upon busts and statuary, and will, I expect, be able to produce a miniature representation of either, in which the resemblance will be faithfully preserved.*

BLACKFRIARS-BRIDGE.

In September, 1832, the Court of Common Council appointed a committee to take the necessary measures to ascertain the effects which the change in the river had made on the condition of Blackfriars-Bridge, and how they might best be remedied. Messrs. Walker and Burges, civil engineers, were selected by this com-

* Philosophical Magazine.

mittee to make a survey of the bridge and estimate of the necessary repairs; and on the 25th of April last, the Report of these gentlemen was laid before the Common Council. As this report contains matter of great interest to the public at large, as well as to the engineer profession, we shall transfer it, with but little abridgment, to our pages.*

REPORT.

Our first object was the survey of the bridge. As the common diving bell appeared to us from its size to be inconvenient for examining the foundations, without a large excavation near the piers, which it was desirable to avoid, and from its not affording the opportunity of examining the vertical face of the stone work, we applied to Mr. Barnard, M. P., who has an interest in Deane's patent diving helmet, for the use of that machine. Mr. Deane brought it from Portsmouth, and has attended us during the survey, having, as well as ourselves, frequently descended to the foundations and examined the work by means of it.

Timber and Stone of Foundations.—The first particular object of our survey was the condition of the timber and stone work of the foundations of the piers. For this purpose excavations were made by dredging down quite to and under the level of the caisson bottoms; and the condition as well as the levels of the timbers, of which we took several specimens, were ascertained beyond doubt by the diving helmet. In cases where digging and examination by the diving helmet were thought unnecessary, boring was resorted to, and we are enabled to say that the timber which forms the foundation of the piers is in a sound and perfect state. The specimens when first cut appeared as bright and fresh coloured as new timber.

Every part of the bridge, so far as we have ascertained, is built of Portland stone, which is of a soft calcareous nature, and subject to decay from exposure to the weather; but we can, from our surveys, state with some confidence that all the stone work, from the foundation up to low-water mark, is as good as the day it was laid, the mortar entire in the joints, and the tool-marks remaining on the faces of the stones.

Levels of Piers.—Our report of the levels of piers, both as respects the different points of the same pier, and comparing them with each other, is also favourable. We have attached to this Report a list of the comparative levels, to which we beg to refer: it will be seen that the greatest inequality in the level of any one pier does not exceed 4½ inches, and that the greatest variation in any two points of different piers is not more than six inches. Supposing even that all the points refered to were originally quite level, which with caissons it is very difficult to accomplish, the work has settled very little, and there would be nothing to apprehend on this score if the state of the river had continued the same as when the bridge was built, or as it was previously to the removal of London Bridge, or probably, with little exception, even in its present state.

General State of Bridge.—As respects, therefore, the state of the bridge itself, it may be safely affirmed that up to low-water mark it is perfect, and that the imperfections of the stone work begin from that level. The repairs which are required above it are fully described in the accompanying specification, to which we beg to refer; and shall here only state the principal features, and our reasons for recommending works to the extent we have specified.

*Mechanics' Magazine.—Our limits, however, compel us to abridge the Editor's abridgement.

Piers and Abutments.—From the level of low water before the removal of London Bridge to nearly the high-water mark, the whole of the stone work forming the front of the piers and abutments is in so very dilapidated a condition as to make new facing with better stone the only prudent and safe plan of repair. The ends or cut-waters of the piers, being more exposed to blows from barges and ice, are still more damaged, and so shaken as to render a renewal from the footings absolutely necessary.

Levels of Tides and Facing required.—Previously to the removal of London Bridge, the low-water mark was seldom under the top of the offset courses of the piers, and in the great proportion of tides still higher, so as to protect the first course above the footings, which is in a much better condition than those above it. The result of the removal of the old bridge has already been to reduce the level of low-water about 22 inches at Blackfriars-Bridge, and as this effect will increase as the remainder of the piers of London Bridge are cleared away, we have no hesitation in recommending that the new facing should commence from the offsets,* and be carried one course or about 2 feet 3 inches on the average above the high water of ordinary spring tides. *Extreme* tides are 3 feet above the level of ordinary spring tides, but as such tides occur seldom, their action on the stone is not to be feared. We consider that the effect on the high water above London Bridge, by the removal of the old structure, is already produced to nearly its full extent, which we never considered would be more than raising the level above one foot, as stated in Messrs. Walker and Leach's Report to the Navigation Committee in 1821, being the amount to which the old bridge acted as an obstruction to the free flow of the tide, or the difference between the level of high water on the two sides of the bridge. The level proposed for terminating the new facing we, therefore, think ample : the whole height of new work will be 18 feet and 3 inches, which will extend round all the piers, and in addition to this, the quoins of the arches will be renewed 5 feet higher. We propose the cut-waters and shoulders of the piers, and the quoins or facing archstones, to be of granite, the other parts to be of Bramley-fall or some other equally durable stone.

Columns.—From the very dilapidated state of the cut-waters of the piers, the columns which rest upon them are endangered, particularly towards their bases, by which the high tides have reached and decayed the stone: some of them have besides been struck by barges which have displaced the lower stones of the shafts, so that these columns are really dangerous. A heavy blow on the disturbed stones might be the means of throwing down the column altogether, and the recess over it would follow ; the consequences of this might be very serious, both with reference to the lives of the persons in the barge, and of those in the recess at the time, who would probably be precipitated with the falling column into the river.

Alteration in Level of Cut-waters.—We propose that the finish of the cut-water, which forms the foundation on which the columns stand, should be raised 2 feet 8 inches, the present low level having been the cause of the decay near the bases which we have refered to ; this will be the more necessary when the addition to the rise of the tides is considered. The columns, we have no doubt, originally stood level with the high water of spring tides, and they are so shown on the engraved elevations ; but the standard of ordinary spring tides, as fixed by the Trinity House in 1800, is 10 inches on the average above the foot of the columns, so that, the

* This is supposing the repairs to be done without the coffre-dams hereafter refered to.

London Bridge dam being removed, the bases are now generally covered with water at spring tides. We recommend shortening the columns without lessening their diameters.

Architraves and Balustrade.—The architraves over the columns are also proposed to be renewed. The balustrade or parapet requires to be noticed more particularly: it is at present in a very dilapidated condition, a great number of the balusters being broken or otherwise injured, and the capping in a very bad state. Having paid great attention to this point, we do not see any way so effectual, and, on the whole, so economical, as having new balusters for the lower or east side of the bridge, and transfering the soundest of the present ones to make good the deficiency on the west side. New capping of good stone is proposed for both sides, and as the base on which the balusters stand must be repaired and reworked, we propose to reduce its height about 3 inches, which will take off the defective parts of the stone and make the balustrade of a better level as respects the view of the river than it now is.

Arch stones.—The broken and defective arch stones, which have been measured one by one, are all to be taken out and replaced with new; the whole of the facing and soffits of the arches thoroughly cleaned, the joints pointed with pozzolano mortar, and generally, in addition to what has been stated, every part of the bridge is to be thoroughly repaired as is particularly described in the specification.

Lowering Causeways.—We have included also the lowering of the causeway on both sides of the river, and the ground under three of the arches on the City side, and one arch on the Surrey side. The increase which will thus be given to the waterway will be an improvement, and the cost trifling, as the material is proper for ballast.

Estimate.—The estimate of all the works contained in the specification amounts to the sum of 58,305*l.*, which includes an allowance of 15 per cent. for contingent expenses and superintendence.

Change of Bed of River.—On comparing the bed of the river, with the present levels, a great difference is observable, particularly on the City side. The low-water mark, which appears to have reached the middle of the first arch on this side, does not now go much beyond the middle of the third arch. Round the second pier there is shown a depth of 8 feet at low water; it is now dry, and there is nearly the same difference in the level of the ground round the first pier. The variation is less towards the middle of the river, and on the Surrey side there is not much change; if any, the depth appears to have increased. But the most important difference, as affecting the stability of the piers, is near their *shoulders*, compared with the present depths in the line of the *middle*, particularly of the four piers on the south of the fourth arch, from the City side. There is little doubt of the ground having been left at least as high at the ends and shoulders of the piers as in the middle. Beginning at the fourth pier from the City side, or the Middlesex pier of the centre arch, the ground towards the middle of the pier is 6 feet above the tops of the bearing piles, or bottom of the caisson. Near the upper or west end of the same pier it is generally only 2 feet above the piles, and for 6 feet in width it is actually below the tops of the piles, and has washed from under the bottom to a depth of 18 inches; so that a boat-hook could be thrust 5 feet under the caisson bottom, of which this angle is therefore entirely unsupported, except by one or two bearing piles. Near the lower or east end of the same pier it is on the average only 2 feet above the piles, or level with the top of the timber

platforms. The levels and differences of the Surrey pier of the centre arch are similar to the one we have described. At the sixth pier from the Middlesex, or third from the Surrey side, the ground is from 2 to 4 feet lower towards the ends than at the middle; the average level towards the ends being only 1 foot above the piles at the west end, and from 2 feet to 2 feet 6 inches at the lower end. At the ends of the second pier from the Surrey side the ground is from 2 to 2 feet 6 inches lower than in the middle, and only 1 foot to 18 inches above the bearing piles.

Effects of Removal of London Bridge.—We had no information to guide us as to the section of the ground previously to the removal of London Bridge; but there is little doubt that the additional scour thereby caused has been the principal if not the only cause of the deepening at the piers.

Shoot through London Bridge.—We have also made a series of observations on the fall, or shoot, at Old London Bridge, with a view to ascertain its present extent, compared with what it was before any part of the obstruction was removed, that we might thereby form a judgment if the scour through Blackfriars-Bridge is likely to be increased. The average of our observations gives a fall from Old Swan Stairs to Billingsgate of 2 feet 4 inches at the low water of spring tides. On reference to the table of tides, taken under the direction of Mr. James Montague in 1820 and 1823, we find that a fall of a similar tide was 4 feet 4 inches. The difference, therefore, is already lessened 2 feet; but we think that the entire removal of the old bridge, and the shoals near it, will reduce the present shoot of 28 inches to 4 inches; or, in other words, that the water above bridge, already fallen 2 feet, will fall 2 feet more, and that the velocity and scour through Blackfriars-Bridge will be much increased. The direct effect of this will be still more to undermine the bridge, unless effectual means be taken to prevent it.

Securing Foundations.—The plan we would propose for this purpose is to drive a complete row of close piles, 12 inches thick and 13 feet long, with guide piles and walls round five of the piers, the heads being level with the top of the caisson bottoms, and to build up the spaces between the piles and the piers solidly with stone laid to a proper slope. One of the modes that may be adopted is that used at Westminster Bridge, which is to drive the piles in the water, and afterwards cut off the heads to the proper level in the diving-bell, and to do the masonry also by the bell. We have prepared an estimate of this, and make the expense 23,966*l.*, including contingencies, &c., as before, which, with the sum already stated for the other repairs, make a total amount of 82,271*l.* But the most effectual plan is undoubtedly by means of coffre-dams, as they will at the same time give an opportunity of examining every part of the foundation, and enable the stone-work between high and low water to be done in the dry, which is both better and cheaper than in the tide. The amount of dams and piling for the five piers, allowing a deduction for the difference of labour in the masonry, is 30,625*l.*, making with the general repairs a total of 88,930*l.*

Time.—Our opinion is, that the repairs from low water upwards, which are stated in the first part of this Report, may be completed in from two years and a half to three years, and that if the coffre-dam plan be adopted, the works of the foundations and superstructure may both be done in three years; but if the diving-bell be used, the time is very uncertain.

Abstract.—Our opinion on the important points refered to in this Report may therefore be summed up in the following abstract:—

	£.	s.	d.
The cost of the repairs above low water will amount in round numbers to	60,000	0	0
The piling, and otherwise securing the foundations, done in coffre-dams, to	30,000	0	0
Making together	90,000	0	0

But, whether as respects the security of the superstructure or the foundations, or the safety of passengers under and over the bridge, the works of repairing either ought by no means to be delayed: no prudent man would, we think, like to take on him the responsibility of the bridge in its present state for any time.

JAS. WALKER.
A. BURGES.

COHESION OF CAST IRON.

MR. EATON HODGKINSON, whose valuable paper on Suspension Bridges was noticed in the *Arcana of Science* for 1833, has been making some "further experiments on the direct cohesion of cast-iron, which will, in a great measure remove the doubts that long subsisted on that important point; proving that when cast-iron prisms are exposed to transverse strains, the neutral line between the tensile and the compressive resistance is not in the centre, according to the theory of Mr. Tredgold; and that the results of Capt. Brown and Mr. George Rennie's experiments, which limit the cohesive strength to about eight tons to the square inch, are confirmed. The experiments were made on a large scale, and with great care to preserve the resultant of the straining force in the line of the centre of the transverse sections."*

* Mr. Bevan, in the Philosophical Magazine.

CHEMICAL SCIENCE.

NEW METHOD OF DETERMINING THE STRENGTH OF BLEACHING SALTS.

The following method for determining the strength of bleaching salts is extremely simple, and may be executed by every one. If we pour into a graduated tube, one measure of common ink, and then add successively, proceeding by *fourths*, $\frac{1}{4}$, 2·4, $\frac{3}{4}$, 1, $1\frac{1}{4}$, $1\frac{1}{2}$, &c. measures of water, we shall of course obtain inks more and more pale in the same proportion. Lines are to be drawn very near together on a sheet of paper, with the inks thus obtained; that is, for the sake of convenience, a line is to be drawn after each addition of the water, which method will readily give us lines growing regularly paler and paler in a fixed proportion. When this is done, we are to cut off with a punch, of the same size, small disks of the paper thus ruled, so that each disk shall contain lines of all the different strengths, from the deepest to the palest. If we now wish to determine comparatively the strength of a sample of chloride of lime (bleaching salts) we have only to take a small quantity of it, and wet it sufficiently to make a conical cake, the base of which must cover exactly one of the pieces of paper, upon which it must be suffered to stand for about five minutes. The number of lines effaced will then give the comparative strength of the chloride.

As these trials are only comparative, we must always make use of the same ink; and a trial should have been previously made with paper ruled by it, and bleaching powder, the strength of which had been accurately determined by other methods; this previous trial furnishes us with our standard of comparison. In the case of bleaching liquors (as Labarraque's disinfecting soda liquid, or the chloride of soda, &c.) a given quantity must be poured into a graduated tube; the trial piece of paper is then to

be introduced into the same, and there to remain for a determinate space of time, to be acted on by the liquid. While the action is going on, it is better to cover the piece of paper by a wine glass or tumbler. Some chloride of lime furnished by Mr. de Rezé, from the mines of de Vic, erased completely all the lines from a piece of paper, whilst the best chloride (of commerce) of Paris, destroyed only 25·40ths of the lines of a piece of paper ruled with the same ink.*

ON SEPARATING THE PHOSPHATES OF LIME AND MAGNESIA.

By Mr. G. O. Rees.

When the phosphate of lime occurs in urinary calculi mixed with the phosphate of ammonia and magnesia, it is rather difficult to discriminate between them. I have, however, found the following process to answer this purpose perfectly.

Heat two or three grains of the calculus to be examined to redness, so as to expel the ammonia present, which if allowed to remain would interfere with the future steps of the process by forming a triple salt. The residue is to be dissolved in dilute hydrochloric acid, and a solution of bicarbonate of potassa added in excess; part of the base of the phosphate, whether of lime or magnesia, is now held in solution as bicarbonate, and may be procured as carbonate by filtration and boiling. The carbonate so precipitated must be well washed, in order to free it from the phosphate of potassa, and may then be dissolved in dilute hydrochloric acid; by these means the phosphoric acid is entirely expelled from the earths, and their usual tests now act characteristically. Thus if magnesia be present, ammonia produces a precipitate soluble in a solution of muriate of ammonia; if lime be in the solution, oxalate of ammonia precipitates it; and if both earths be present, both these indications are fulfilled.

This property which the bicarbonate of potassa possesses of decomposing the phosphates, is only available in qualitative examinations; as the conversion into carbonate is only partial. The use of the salts of lead in freeing the earths from phosphoric acid requires much time and attention; whereas the process here recommended, occupies but a few minutes, and though not so complete in its effects, answers completely to distinguish the earths when combined with the phosphoric acid.†

THE MODULUS OF ELASTICITY OF GOLD.

By B. Bevan, Esq.

It is something remarkable that while the modulus of elasticity and stiffness of a number of the common metals have been inves-

* Journal de l'Academie des Sciences.
† Philosophical Magazine.

tigated and determined, that of gold, which is considered the most valuable metal, should have been neglected, or overlooked. To supply this defect I have lately obtained a piece of pure gold, and have ascertained the measure of its elastic force to be about 11,690,000 pounds to the square inch, or 1,390,000 feet when recently drawn into wire, or about 1,000,000 feet lower than the modulus of platinum, and 5,000,000 feet less than that of plate-glass. I suspect, however, that the modulus of gold as alloyed for coinage, is something higher than that of pure gold; but at present I have not been able to procure a piece of suitable dimensions to demonstrate it.

Those who are in the daily habit of taking gold coin soon acquire a knowledge of the proper sound or note given upon striking a piece of money upon a table or hard substance; this well-known though undefined note or sound depends upon the modulus of elasticity of the metal, as well as upon the diameter and thickness. A piece of coin, of the same dimensions, both as to diameter and thickness, of silver, will give a note about a major fifth higher than one of gold, when a similar coin of copper will give a note an octave above that of gold; and if made of steel would give a note a minor third above that of copper.

To convince any person of the influence of the modulus of elasticity of metals on the musical sound produced by them, let them have a tuning-fork made of bell-metal, of the same length and thickness as a fork made of steel: they will find the note given by the bell-metal fork a fifth lower than the note from steel.

The stiffness of gold, against taking a permanent set or flexure, I find about two-fifths of that of brass; one-fourth of the stiffness of wrought iron, and one-eighth of that of untempered steel.*

GAS-LIGHTING.

Mr. George Lowe, of Brick Lane, Old Street, has patented means for increasing the illuminating power of Coal Gas; also for converting the refuse produce from the manufacture of Coal Gas, into an article of commerce not heretofore produced therefrom; also a new mode of conducting the process of condensation in the manufacture of Gas for the purposes of Illumination.

The first part of Mr. Lowe's invention, that is, for the increasing of the power of illumination in gas, adding brilliancy to the light, and giving intensity to its lustre, is simple, original, and effective. It is procured by the impregnation of the gas with naphtha, commonly called the spirit of coal tar, or any other hydro-carbonaceous liquid. The means by which Mr. Lowe brings about this impregnation are, simply, the filling a common gasometer to a certain pitch with one of the liquids above described, instead of water. It is necessary, however that the

* Philosophical Magazine.

supply should be constant and regular, and this is easily managed by the application to the gasometer of any self-acting apparatus, such as the bird fountain. So simple and certain a way of increasing the force of the illuminating power has never been before suggested.

The second part of the invention is wholly independent of the first, and might be the ground of a distinct patent. This is the production of the colour, called in commerce, "Prussian blue," from the refuse of the coal gas preparation. Mr. Lowe is evidently a superior practical chemist; he proposes to procure the Prussian blue pure, or in combination with sulphate of lime: the former, from the ammoniacal liquor; the latter, from the lime-water with which the gas has been purified.

To produce the pure Prussian blue. Take one ounce of sulphate of iron, (green vitriol) in solution with water, and mix it well with each imperial gallon of the ammoniacal liquor of the specific gravity 1·031. When this has duly played its part, and the ingredients are thoroughly mixed, supersaturate the liquor with fourteen ounces of sulphuric acid (oil of vitriol) of the specific gravity of 1·850. There will be a precipitate formed at the bottom of the vessel; this is Prussian blue, which may be collected by decanting, or by infiltration, as usual. The Prussian blue will be as good, and much cheaper than that now in use. We have reason to believe, however, that a production of yet higher excellence, and at a lower cost, is about to be procured by a somewhat similar process.

If you would have the Prussian blue, not pure, but in combination with the sulphate of lime, you must proceed as before directed, mixing one ounce and a half of sulphate of iron of the specific gravity 1·043 with each imperial gallon of the lime water. Then supersaturate with fourteen ounces of sulphuric acid, and the precipitate will be Prussian blue combined with the sulphate of lime, a colour very useful and valuable as an article of commerce.

The third part of Mr. Lowe's invention is also perfectly distinct from either of the preceding. It is a new means of condensing the gas by permitting the escape of coal tar at different temperatures, and, consequently, of various specific gravities. The apparatus is remarkably simple. It is a common condenser, a pipe, declining from the one end to the other, that is set on an inclined plane. To this pipe are fitted five self-acting syphons which permit the almost constant escape of coal tar. That at the highest inclination of the condenser is at the highest degree of temperature, and, by consequence, of the highest specific gravity, while each syphon, as we descend towards the lowest inclination, emits the coal tar at a lower temperaure.*

* Repertory of Arts.

CAUSE OF CRYSTALLIZATION.

M. Gaudin, in considering certain properties of atoms, has pointed out particular cases of an extensive series of experiments regarding the immediate causes of crystallization. According to him, those bodies cleaving in a cube have for their primitive molecule a point or a right line; either an atom (as in metals); two dissimilar atoms (as in sulphuret of lead); three atoms, one of one kind, and two of another, (chloride of sodium); again, those molecules having for their form a double simple pyramid, or a prism of a number of sides, which is a multiple of four, may be assimilated to points when under different circumstances they form in groups around an accidental nucleus, and in this way they sometimes crystallize in cubes. Those bodies which cleave in a *right prism*, with any base whatever, have for their primitive molecule, either the polygon of the base, or a double simple pyramid, or a prism of a number of sides equal or double. When the primitive prism is not cleavable perpendicularly at the axis, it is because the molecules are polarized, that is retained together either by an electric force, or by the force of affinity. The tetaedron, octaedron, and rhomboedron have respectively for their primitive molecule, the first a square, or a rhomb; the second a double tetraedral, or octaedral pyramid, simple or prismed, (prismée), and the third a double hexaedral pyramid of the same nature. Finally, the absence of cleavage in these solids is owing to the want of continuity of the molecules. But in the tetraedron the want of continuity depends solely on this state of polarization, whilst in the octaedron and rhomboedron it results from the agregation of the molecules.*

PRESERVATION OF IRON FROM RUST.

M. Thenard has reported favourably on the observations of M. Payen regarding the property which alcaline solutions possess, of preventing the oxidizement of iron and steel. "The fact," says M. Payen, "is beyond doubt, and a circumstance worthy of remark is, that a very small quantity of alcali suffices to produce this result. Let bars of iron or of steel be plunged into common water, and their oxidizement will not be at all retarded: 1·4000 of caustic potash will not preserve them from oxidation; but 1·2000 of this alcali, or of lime water, mixed with its own weight of water, and a fortiori, pure lime water will preserve them from it. Alcaline carbonates and borax, but in much larger proportions, produce the same effect. If then water holding in solution 1·2000 of an alcali were in contact with the air, in proportion as the alcali would attract carbon, the iron or steel immersed in it might be oxadized. Similar phenomena might

* Journal de Chimie Medicale.

probably occur with other metals; it would be curious to submit manganese, zinc, and arsenic to the same process. Probably, water to which there should be added not more than 1·2000 of an alcali, but the same proportion of acid, would produce a quite contrary effect, and the iron would be rapidly oxidized. Is not this one of the reasons why iron filings, sprinkled with water containing a little vinegar, is so easily rusted?"

"Be this as it may," adds M. Thenard, "it is not improbable, that the observation of M. Payen may admit of useful applications. This chemist has already pointed out some; but there are others more or less important, which may now be particularized. Might we not then preserve iron, which would be subjected to no friction, and which, moreover, should be sheltered from rain, by moistening it with an alcaline solution? Why not try to preserve cannons in the same way? and when they are mounted on wood, what is there to prevent one from placing on the cannon after use a sponge soaked in an alcaline solution? The reporter assures us, that an iron bar immersed in an alcaline solution, and then left exposed to the air in a moist place, had not, at the end of twelve hours, lost any of its brightness. If the iron were not protected from rain, it might perhaps be sufficient to cover it with an alcaline coat, and then cover over the coat a layer of varnish. The iron pillars used in metal bridges might probably be preserved from rust in a similar way. The same may be said, no doubt, with respect to iron employed in buildings, and intended to penetrate into the interior of the walls."

M. Thenard relates the fact of two cannons which were deposited in a cellar for better than a week; of which the one, which had been coated with an alcaline solution, to which a small quantity of gum had been added, had lost nothing of its brightness, whilst the other which at the commencement of the experiment was equally bright, was soon covered over with water.*

ANALYSIS OF THE WATER OF RIO VINAGRE.

By M. Boussingault.

A PHENOMENON which deserves to engage the attention of those travellers who visit Popayan is the Rio de Pasambio, the waters of which are acid, and for this reason, the inhabitants of Cordilliere call it Rio Vinagre, the river of Vinegar. The Rio Vinagre rises near the volcano of Puracé, at an elevation of about 4300 metres. As far as the village of Puracé the stream has a subterraneous course, and it is only at Chorrera de San Antonia that the Rio Vinagre can be approached with ease. Chorrera de San Antonio presents an admirable cascade, falling from an height of more than 300 feet, into the midst of an extensive amphitheatre. Two or three miles lower down than Chorrera, the Pasambio, after

* Journal de Chimie Medicale.

receiving the Anambio, empties itself into the Cauca. From the village of Puracé we arrive without much difficulty below Chorrera; but it is painful to remain, by reason of a continual raining of acidulated water, which occasions in the eyes an intolerable itching. A little below the cascade I found that the Rio Psambio was 72 feet in breadth, with a mean depth of 4 inches (pouces) the velocity of its course was 3 feet per second. The water of the Rio Vinagre is perfectly limpid; its specific gravity is 1,0015; it possesses a well-marked acid taste, mixed with an astringency which denotes a salt of alumina; it reddens tincture of turnesol, even after it has undergone continued boiling; when placed on zinc filings it occasions a sensible disengagement of hydrogen. Reagents indicate in this water sulphuric and hydrochloric acid, lime, alumina, and traces of iron and magnesia. I shall here state the results I obtained in an Analysis made at Puracé in April 1831. 422 grammes of water of the Rio Vinagre gave with nitrate of silver 20·1 grs. of a chloride, equivalent to 0·384 gr. of hydrochloric acid. 422 grammes of water, treated with chloride of barium, produced 1·35 grs. of sulphate of baryta, containing 9·464 gr. of sulphuric acid. 422 grammes of the water of Vinagre were reduced by evaporation; caustic ammonia poured into this water gave rise to a precipitate of alumina which weighed 0·17 gr.; this alumina contained iron and magnesia. In the liquor deprived of alumina, the oxalate of ammonia precipitated the lime; the oxalate of lime, converted into a carbonate, weighed 0·10 gr., containing 0·056 gr. of lime. The liquid then containing neither lime nor alumina was evaporated, and after driving off the ammoniacal salts, there remained a residue of alcaline salts with a base of soda. These salts were changed into a sulphate; the sulphate of soda at first weighed 0·13 gr.; but on dissolving in water it yielded 0·01 gr. of silica; its weight was thereby reduced to 0·12 gr., amounting to 0·05 gr. of soda. According to this analysis the water of Rio Vinagre contains

Sulphuric acid	0.00110
Hydrochloric acid	0.00091
Alumina	0.00040
Lime	0.00013
Soda	0.00012
Silica	0.00023
Oxide of iron, magnesia	same traces.

If we admit that the alumina and lime are combined with the sulphuric acid, the composition of the Rio Vinagre may be expressed as follows:—

Sulphate of alumina	0.00131
Sulphate of lime	0.00031
Chloride of sodium	0.00022
Silica	0.00023
Hydrochloric acid	0.00081

This is, however, but a supposition: it is even probable that it is rather to the sulphuric acid than to the hydrochloric acid that the water of the Psambio owes its accidity; for I could not discover any free hydrochloric acid in the products of the volcano of Puracé. In the crater of the volcano of Pasto I discovered a considerable quantity of an acid sulphate of alumina, which communicates to water an acid and astringent taste; the analysis of this sulphate, which I intend to set about forthwith, will no doubt throw some light on the composition of the salts contained in the water of the Rio Vinagre, and on the nature of the free acid found in it.*

ACTION OF MAGNETO-ELECTRICITY ON THE TONGUE.

By Mr. F. Watkins.

Among the several electrical effects exhibited by natural artificial steel, and electro-magnets, none are in my estimation more curious than that produced on animals. Dr. Faraday in his excellent paper on experimental researches in electricity, published in the Phil. Trans. of the past year, observes in page 138, that when using an armed loadstone of great power, belonging to Prof. Daniell, he convulsed a frog powerfully, and adds with a diffidence so peculiarly his own, that "I thought also I could perceive the sensation upon the tongue, and the flash before the eyes." That this eminent philosopher did observe the phenomenon in a slight degree (at this moment) there can be no doubt; but as the effect was feeble, in consequence of the exciting cause not being sufficiently powerful, he alludes to it in the manner here quoted.

Through the kindness and liberality of the proprietors of the National Gallery of Practical Science, Adelaide Street, West Strand, I have seen and performed several magneto-electric experiments with great success, with their superb artificial steel magnet; and as I have not noticed in print anywhere else than in Dr. Faraday's paper, that the tongue had been electrified (if I may use the expression) by a magnet, I shall briefly recount what R. W. Fox, Esq., Mr. Saxton, and myself, experienced on the 5th of June last.

Two slight copper wires were so disposed, that while one had an end connected with the ascending portion of the compound helical wire surrounding the armature or lifter of the large magnet, the other was joined to the descending portion, thus affording the means of completing the circuit in the mouth. When the free end of one wire was situated underneath the tongue, and the free end of the other placed above that organ, and in contact,—on breaking the connexion between the armature and magnet, a shock was felt; and when the process was repeated several

* Annales de Chimie.

times, the sensation was truly painful. Hence the original observation of Dr. Faraday was perfectly correct.*

COMBINATIONS AND PROPERTIES OF ZINC.

Besides the different metals that have been long since known to exist in the zinc of commerce, M. Schindler has recognised in it the presence of uranium, and of a combination of carbon with zinc. Both are found in the blackish residue obtained by the solution of zinc in sulphuric acid; uranium, however, but in very small quantity, (1 grain from 2 pounds of zinc). It is to the presence of the carburet, that the odour always possessed by hydrogen obtained from commercial zinc is to be attributed. M. Schindler attributes the yellow colour which the oxide of zinc, obtained by calcination, almost always possesses, not to iron, as is generally supposed, but to the presence of a new metal which he has not been able to separate. Although oxide of zinc is easy soluble in solution of potash, it is with difficulty, and only in small quantity dissolved by water of ammonia; the presence of an arseniate or a phosphate, even in very small quantity, enables water of ammonia to dissolve it in considerable proportion. Ammonia cannot be said to throw down oxide of zinc, as the oxide retains a quantity of the alkali which cannot be separated without great difficulty, and which attracts carbonic acid.

He has obtained an hydrate of oxide of zinc in small rhombohedral crystals, by plunging into water of ammonia, iron and zinc connected together. A very abundant disengagement of hydrogen takes place, and the crystals are deposited on the sides of the vessel, and on the zinc; these are very brilliant, and are by heat converted into the powder of the anhydrous oxide: they are composed of 1 atom of oxide + 1 atom of water.

The hydrated sulphuret of zinc can be obtained in small crystals composed of 1 atom of sulphuret = 1 atom of water; heat separates but one half of the water, the remainder cannot be separated until the sulphuret be decomposed. The common sulphate of zinc contains, according to M. Schindler, 7 atoms of water, not 5 as is generally admitted.

Besides these different bodies, he has described three basic sulphates of zinc. The first, the *Sulphas Bi-zincicus*, is soluble, uncrystallizable, and very easily decomposed. The second, *Sulphas Quadri-zincicus*, cannot be obtained in the anhydrous form; it is crystallizable and scarcely soluble in water. Heated to a temperature of 80° or 100° R., it loses a portion of its water, and its composition corresponds then to a salt hitherto considered to contain three atoms of oxide. The third of these salts contains eight times as much base as the neutral salt, and

* Philosophical Magazine.

is insoluble in water. Heated strongly, it is decomposed into pure oxide of zinc and neutral sulphate, in consequence of the loss of the water necessary to its composition.*

COLOURING MATTER OF CORNELIAN.

HITHERTO it has been considered that the cornelian was coloured by the oxide of iron; an observation of Dufay's, however, was opposed to such an opinion; he found that if cornelians be heated alone in such a manner that they do not split, their colour is not altered, but that if they be covered with a cement containing oxide of iron, they become white wherever the cement touched the stone. M. Gaulty de Claubry was induced to turn his attention to the subject by the above fact: and, on experiment, he found that when powdered cornelians were mixed with black oxide of copper, in a porcelain retort, and heated to redness, carbonic oxide, and carbonic acid were disengaged, and some pyro-acetic acid, and some pyro-genic oil formed, proving that the colouring matter of the mineral of an organic nature.†

PREPARATION OF CITRATE OF QUININE.

By Dr. Galvani, Emeritus Professor of Pharmacy at Venice.

LET one part of sulphate of quinine be dissolved in forty parts of pure boiling water, and, at the instant, pour gradually into the solution acidulated citrate of soda; at first litmus paper is not reddened by the liquor, but on adding gradually more citrate of soda, the paper is turned red, which is a sign that the decomposition has been perfectly effected, and that citrate of quinine is formed. The liquor is to be filtered while near boiling, and on cooling the salt crystallizes; at the end of six hours, the crystals are to be separated from the mother liquor, drained, and washed with a little distilled water, and pressed. They may be dried between folds of bibulous paper, in a stove with a very gentle heat. Having evaporated the mother water, more crystals are obtained, and the whole of the salt is thus gotten pure.‡

ON THE FORMATION OF HAIL.

By Professor De Perevoschtchikoff.

To explain the cause of the formation of hail two questions must be resolved, how are the nuclei of the hailstones formed, and how do they acquire a considerable volume? Now there is no doubt but that these nuclei, nearly always transparent, are the frozen drops produced by the reunion of the innumerable globules

* Archiv. der Apotheker Vereins.
† Annales de Chimie et de Physique.
‡ Annali Universali di Medicina, Luglio.

of which the clouds are formed. But it is not easy to explain the cause of the cooling of the clouds, for the hail constantly falls during the hottest portion of the year. Guyton de Morveau, and Volta, admitted that the cooling is due to rapid evaporation, depending on the intense action of the solar rays, on the dryness of the atmosphere, and on the influence of electricity which accelerates evaporation; but Bellani thinks that this opinion is erroneous. To determine whether it be exact, M. Perevoschtchikoff has made experiments in which he used two thermometers, of which one had a recurved reservoir, the cavity of which contained a teaspoonful of liquid. The two thermometers were exposed to the sun, and at the same time alcohol and water submitted to its action.

It results from his experiments, made with each of these liquids, that a prompt evaporation produces cold even under the direct rays of the sun; and that the temperature of a liquid which evaporates cannot rise except the evaporation is very slow. There is then no doubt that the cause of the primitive formation of the hail, arises from the rapid evaporation of the little globules of which the clouds are formed.

Volta supposed that the hailstones enlarged by their alternate contact with two clouds differently electrified. M. Perevoschtchikoff thinks their increase of size may be better accounted for as follows:—When the clouds form many thick layers, they become an obstacle to the free distribution of radiant caloric, which being then reflected to the earth, produces that stifling heat which generally precedes the storm. Above the clouds the sky is perfectly serene, and does not prevent the radiation from the superior portion of the clouds. This is the principal cause of their cooling, from whence arises the formation of the hailstone nuclei. The weight of these bodies not allowing to remain suspended in the air, they fall to the ground, and in their descent passing through numerous layers of clouds, they acquire at each a new opaque coating of liquid, congealed at the surface, so that the number of layers of which the hailstones consists, depends on the number of strata of clouds. Thus electricity is not (according to M. Perevoschtchikoff,) the necessary cause of hail, it is only an accidental concomitant, and the lightning rods erected in gardens to defend them from hail are not of any real use.*

MAGNETIC INTENSITY INSTRUMENT.

At a late meeting of the Royal Society, we had an opportunity of seeing the apparatus of Mr. Snow Harris, for obtaining observations of magnetic intensity *in vacuo*. This is by far the most perfect for making these observations, that we have yet seen. The needle was suspended by a silk fibre passed through a small hole in its centre, and was allowed to oscillate at the

* Transactions of the Imperial Academy of Sciences of Moscow.

bottom of a glass tube, from which the atmospheric air had been previously exhausted by an air pump. By vibrating the needle *in vacuo*, Mr. Harris is enabled to get a great number of vibrations in small arcs, the intervals of time of an equal number of of vibrations during the same observation, being also nearly similar. The greatest arc used by Mr. Harris, is 5° on each side of zero, while by some observers an arc of 30° is used.

We were much pleased with the whole arrangements of Mr. Harris for making this delicate and difficult observation, and two principal features struck us as being peculiarly adapted to secure accuracy. It is usual, with most observers, the needles being fitted for the purpose, to change the centre of the needle, to compensate for the change of the dip in different parts of the earth's surface, so as to preserve the horizontal position of the needle. This is considered, by Mr. Harris, as highly objectionable, inasmuch as it completely alters the condition of the needle. In order to obviate this, he keeps two small pieces of platinum, one on each side of the centre, and by shifting their distances from it, he preserves the horizontality of the needle under all circumstances. The process adopted by Mr. Harris, of finding this condition, was new to us, and we believe it must be also to many observers. He takes a basin of water, coloured with indigo, (or any thing else,) and suspending the needle over it by its thread, he observes, whether the needle and its shadow on the surface of the water are parallel. If they are so, the needle must be horizontal as the surface which reflects the image is so, but if it be inclined to the horizontal position, the angle at which it is inclined is doubled by reflection, and rendered at once conspicuous. Indeed, an experienced observer might contrive to see a contact between the needle and its shadow, without allowing the former to touch the surface of the water.

In commencing his vibrations in a certain arc, Mr. Harris uses a pair of arms which embrace the needle on each side, and holding it at the extent of the arc, lets it go instantaneously. The common method is to apply a magnet, and, by withdrawing it suddenly, the needle commences its vibrations.

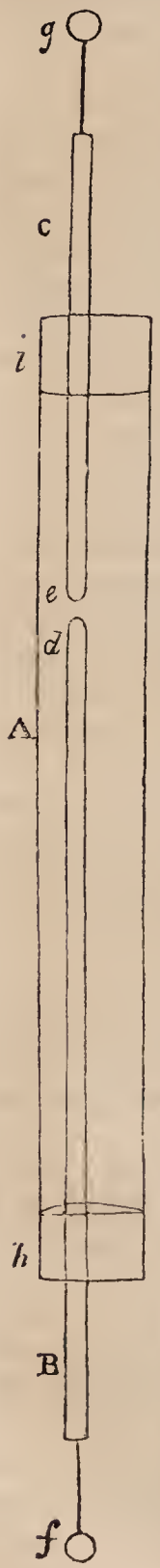
Mr. Harris also proposes to ascertain comparative observations of the force of gravity, by the vibrations of a bar of metal, in a very simple and ingenious manner. He suspends the bar at the middle by two parallel threads, and observes the number of vibrations through a certain arc in a stated interval of time. This interval always being the same, the number of vibrations will vary, according to the force of gravity at the place where the observation is made.

A new electrometer was also shown by Mr. Harris, of his own invention, which indicated very distinctly, the presence of the minutest quantity of electricity.*

* Nautical Magazine.

ELECTRICAL EXPERIMENTS—DECOMPOSITION OF WATER.

A DESCRIPTION of the following cheap and simple apparatus, exhibiting the decomposition of water by common electricity m probably be interesting to young experimentalists.*



A is a piece of glass tube, say five or six inches long, one-half to five eighths of an inch diameter, the ends which should be filed or rubbed smooth. B C are two pi of thermometer tube, at whose extremities, *d e*, half an i of very fine gold or platinum wire must be inserted. T ends of the tubes should be fused, so as firmly to retain wires. This can be easily effected with a blow-pipe spirit lamp. The finer the wire is the better. After fus should the wires project, they must be cut or ground do parallel with the ends of the respective tubes. *f g* are t pieces of brass or copper wire, passing throughout whole length of the tubes B C, and in contact with the g or platinum wires at *d e;* with a little care, these w may be united to the tubes at B C by fusion. *h i* are c nicely adapted to the ends of A, and through whic tubes B C pass. If these corks be covered with sealing- it will give to the apparatus a more workman-like ap ance. The mode of operation is as follows:—The c *h* being permanently fixed, fill the tube A with w insert the cock *i*, so that the points *d e* shall be with eighth of an inch of each other; attach the wire *f* t discharging rod, or which is much better, to Cuthbert grain weight electrometer, holding the other end of th paratus *g* in the hand. When the machine is in a bring the ball of the discharging rod, or of the electron as the case may be, to within a rapid striking distan the conductor, when brilliant sparks will be seen t from *d* to *e*, decomposing a minute quantity of water transit. The success of the experiment will be manife by bubbles of gas (oxygen and hydrogen) ascending thro the water. With this simple apparatus a sufficient quant of gas may be collected to produce an explosion with taper. It is important to remember that a continuous flo of the electrical fluid is not sufficiently energetic to resol water to its elementary principles. The intermitting spar is essential to the due performance of the experiment. the tube at *g* be connected with the floor, the results are so satisfactory. The human body is a more perfect conductor than the floor; hence the evolution of gas is most abundant when the positive end of the apparatus communicates with the hand.

The decomposition of water by a galvanic battery is more imposing than by the above process. This experiment, however, is interesting, because it demonstrates the identity of common and voltaic electricity. I may, however, expect soon to have farther proof of the identity of electricity and magne-

* Mr. Rutter—in the Mechanics' Magazine.

tism, in the decomposition of water through the sole agency of the magnet.

REMARKS ON ELECTRICAL DECOMPOSITIONS.

By William M. Higgins, F.G.S. and J. W. Draper.*

METALLIC reduction by the galvanic battery is always conducted in one of the three following ways :—Either the substance to be decomposed is presented in solution with water, as in the case of sulphate of copper and nitrate of silver ; or it is only moistened with water, as when hydrate of potassa is acted upon ; or it is presented in a liquid form by heat, as in Davy's experiments with the carbonate of lithia.

The galvanic battery has generally no effect on solids, so that metallic salts must be presented in the form of solutions, for effectual decomposition.

All the simple bodies are either very good or very bad conductors ; and the greater the number of substances in a compound, the more easily is it decomposed.

At temperatures between 40° and 120° F., compound substances, not containing oxygen as one of their elements, are non-conductors of galvanic electricity.

When metallic salts in solution, with an excess of water, are presented to the galvanic battery for decomposition, no hydrogen gas is given off at the negative pole, if the power of the battery be proportionate to the strength of the solution, provided the revived metal can exist in water. If it cannot exist in water, then, as soon as an equivalent is revived, decomposition of the water ensues, and hydrogen gas is liberated. This is the case with potassium and sodium. That a real decomposition of the oxide has taken place appears, when we submit mercury, in contact with a solution of muriate of soda, to the battery. Chlorine is evolved from one pole, and hydrogen, with which it was before combined, uniting with the oxygen of the sodium, forms water. Now, in this case, the mercury may act as a kind of endless valve ; for from the intense affinity which it possesses for sodium, it instantly allows it to penetrate, and to be diffused through every part of its mass ; but by excluding the water of the solution, no action can take place on the sodium, save only on that part which exists merely at the surface of the amalgam.

There is, however, between these extremes, a class of metals, manganese is an example, which, in a very comminuted state, decompose water at common temperatures, although they cannot effect it, when they are in mass. The galvanic battery cannot revive any metal in solution, which is not reducible by means of hydrogen gas, below a red heat ; and, in all these cases, this view may in general be taken, that the electrical decomposition

* Author of "The Mosaical and Mineral Geologies, illustrative and compared."

of an oxide is produced by nascent hydrogen. If peroxide of iron be exposed to a current of hydrogen, decomposition ensues, water is formed, and a black cinerous substance is left, which, though it is a non-conductor, is pure iron, and, in this state, will often inflame at 100° F. The same happens when a saturated solution of protosulphate of iron is decomposed by electricity, the hydrogen which would be liberated from the negative pole, is expended in reducing the protoxide of iron; and the more violent the voltaic action, the more comminuted will be the metallic matter produced; and, in this state, even at low temperatures, iron has the power of decomposing water.

When the substance to be decomposed is merely moistened with water, we still bring the reducing agency of hydrogen into action. Hydrate of potassa is a non-conductor; but, when a new compound of it is formed with water, that compound is not only a conductor of electricity, but is more readily decomposed. The first object is to dissolve the surface of the hydrate in the smallest possible quantity of water, so as to give it a conducting power. The action produced is then sufficient to separate the water, and to melt the hydrate; one equivalent of the oxygen is given off from the water of the hydrate, and its corresponding equivalent of hydrogen uniting with the oxygen of the potassa, the metal is separated. The process is analogous, when the hydrate of potassa is decomposed in a gun-barrel. The iron unites with the oxygen of the water of the hydrate, at a white heat, and the nascent hydrogen separates the oxygen from the potassium, the water produced being simultaneously decomposed by the iron. The facility of this decomposition is doubtless owing, in a great degree, to the volatile nature of the potassium, and the fixidity of the oxygen of iron. But we may be certain that hydrogen is the main cause, for oxide of potassium is decomposed, in like manner, at a white heat. Gay Lussac and Thenard have shown that hydrogen cannot decompose hydrate of potassa, on account of the water it contains, which must be decomposed before any action on the oxide can be produced.

At temperatures between 40° and 120° F., no decomposition can be effected by the voltaic battery, if hydrogen gas does not exist in the substance, and is not presented to it in a nascent state. And as, at the same temperatures, no substance is a conductor which does not contain oxygen as one of its elements, therefore water must always be present in all galvanic arrangements for decomposition at those temperatures. But at temperatures greater than 300° F., we meet with many fluids of such conducting power that, without the presence of either hydrogen or oxygen, they may be decomposed by the battery. This is the case with liquid iodine of potassium and chloride of sodium.

Every instance of reduction effected by the galvanic battery,

at temperatures between 40° and 120° F., may be performed by chemical means, when hydrogen gas is employed, and evolved under similar circumstances, provided the temperature be higher than a red heat.

These few results, from a long series of experiments, are presented to the scientific, as important principles in electrical decompositions. It is, however, much to be regretted that galvanic arrangements have been so little improved. Nearly all the results mentioned in this paper have been determined by experiments made with four pair of half inch plates, mounted in tubes, as Berzelius recommends, which, in decompositions, have a decided advantage over eighty pair of four inch plates.*

ON THE CONDUCTING POWER OF THE METALS FOR HEAT AND ELECTRICITY.

By James D. Forbes, Esq. F.R.SS. L. and Ed.

THE author was led to a careful examination of the existing determinations of the conducting powers of the metals for heat, by some collateral trains of experiment in which he was occupied two years ago. He points out the degree of confidence which may be placed in the *arrangement* of conductors given by different authors; for we appear to be far from reaching a correct estimate of their numerical values. In viewing those of M. Despretz as the best, he remarks, that the position of platinum, which is certainly erroneous, shows how imperfectly we can depend upon experiments on this point, made with even more than usual care. Platinum is placed, by this writer, almost at the top of the list, between gold and silver, whilst the commonest experiments serve to show that it is really a very imperfect conductor.

In order to verify the conclusions of previous observers, and to determine the position of some metals upon which no experiments seem to have been made, the author employed Fourier's Thermometer of Contact, an elegant instrument, which he believes has not before been practically applied. His experiments, however, being only intended for the illustration of a subject of collateral inquiry, were not made with the detail that they would otherwise have been, nor are they presumed to be perfectly accurate. They served, however, to confirm previous experiments on the order of the metals, as conducting substances; to restore platinum to its right place, and to fix the positions of antimony and bismuth. From these and other data he considers the following as the most probable arrangement of conductors of heat, beginning with the best:—*Gold, Silver, Copper, Brass, Iron, Zinc, Platinum, Tin, Lead, Antimony,* and *Bismuth.*

* Jameson's Journal.

In like manner, by a careful comparison of the results of Harris, Becquerel, and Pouillet, including some experiments on antimony and bismuth, made at the author's request by Mr. Harris, he concludes, that the arrangement of the metals, as conductors of electricity, is the following, which he observes is probably better established than the corresponding one for heat: —*Silver*, *Copper*, *Gold*, *Zink*, *Brass*, *Iron*, *Platinum*, *Tin*, *Lead*, *Antimony*, and *Bismuth*. He observes, that the deviations from a common arrangement only occur, where it is agreed by experiments on both points, that the metals are extremely closely allied; as for example, Gold and Silver, Iron and Platinum. His general conclusion is this: That the arrangement of conductors of heat does not differ more from that of conductors of electricity, than either arrangement does alone under the hands of different observers.*

OBSERVATIONS ON PHOSPHORUS.

By John Davy, M.D. F.R.S.

In the Number of the *Quarterly Journal of Science* for July and December, 1829, is a paper by Mr. Thomas Graham on the slow combustion of phosphorus, in which he has given an abstract of what was previously known on the subject; and has, besides, added several curious particulars, ascertained by himself.

Before I was acquainted with Mr. Graham's paper, I had been engaged in a similar inquiry, the results of which I now propose to give. Although the greater number of them accord sufficiently with his, some of them are different, and a few of them I believe are new.

It is considered as a well established fact, that phosphorus does not shine in oxygen gas at a temperature below 64°. This is stated by Mr. Graham, and by Dr. Thomson in his System of Chemistry; it is also stated, that phosphorus does not combine with oxygen below the point of fusion. The results of my experiments have been different. In some instances, in which I have introduced phosphorus into oxygen obtained from chlorate of potash, it has not shone in the dark between 60° and 80.° In others, it has shone very feebly, even more feebly than in common air; the oxygen not having sensibly diminished in a volume in the course of several hours. In others, it has shone very brightly, sometimes by fits, flashes of light appearing and disappearing; and sometimes without interruption, with an intensity, though infinitely below the violent combustion of phosphorus, so much above its very slow one, that the heat produced fused the phosphorus, and the ascent of the water or mercury in the tube was visible in progress, and occasionally rapid, and yet never breaking out into vivid inflammation.

* Jameson's Journal.

To what these differences of effect have been owing, I have not been able to ascertain; only this far, that they were not concerned with the purity of the gas, at least, in relation to the presence of small variable proportions of atmospheric air, or indeed any appreciable adulteration; or with the degrees of temperature. The most probable mode of explanation of the luminous appearances in different degrees is, that they are connected with the formation of different compounds of phosphorus and oxygen, according to the analogy of the degrees of light emitted by sulphur in combustion; but of the truth of this I have not been able to satisfy myself by experiment.

In accordance with the observations of others, I have found that when oxygen gas is rarefied, phosphorus shines in it; and that when condensed, it ceases to shine. With an augmented pressure of a column of mercury of 16 inches, when heated with a spirit-lamp in this gas, it emitted no light, till it fused; then it burst into flame and burnt explosively, and the oxygen was condensed in an instant.

Dr. Ure states in his Dictionary of Chemistry, that phosphorus soon ceases to be luminous in dry atmospheric air, on account of the acid coat formed on it, which protects the surface from the farther action of the air. This I have not found to be the case. A stick of phosphorus suspended over strong sulphuric acid in a limited portion of atmospheric air, continued shining many hours, till, there was reason to suppose all the oxygen was consumed; and the result has been the same when phosphorus has been introduced into air confined over mercury, and previously dried by the same acid; when its light ceased, a fresh portion of phosphorus thrown up did not kindle. In both instances, the luminous appearance was as bright as in common air that had not been artificially dried.

Compression and rarefaction in the instance of common air, has an effect analogous to that mentioned when speaking of oxygen. In a bent tube, under an increased pressure of 90 inches of mercury, phosphorus did not shine. When the experiment was reversed, it became luminous, and more so than under ordinary atmospheric pressure. The volume of atmospheric air compressed in one instance and rarefied in the other, was about one cubic inch.

The same effect is displayed in a striking manner by heating phosphorus in a retort securely closed. The compression from the intense heat produced when the phosphorus inflames, presently extinguishes the flame, which may be rekindled by allowing a portion of the confined air to escape.

When phosphorus is placed on the plate of an air-pump, under a receiver, and the air exhausted, the brightness of its light in the dark rather increases with the exhaustion, and, in the nearly perfect vacuum formed by a good pump, its light was not diminished. When the air has been suddenly readmitted,

its light has been extinguished, and for a few seconds it has ceased to shine.

When phosphorus has been placed in distilled water under the receiver of an air-pump, and the air dissolved in the water has been exhausted, or taking it into the open air out of the water by a thread attached to it, it has shone with rather increased brightness. If now immersed in common water, and suddenly taken into the atmosphere, it has emitted no light. Many other effects similar to this might be mentioned, showing how circumstances, apparently very trifling, exercise an influence on phosphorus, and promote or impede, in a manner that could not have been expected *a priori*, its union with oxygen, and its luminous appearance depending on this union.

In accordance with the results of Mr. Graham's experiments, I have found that the vapour of ether, oil of turpentine, and every other essential oil that I have tried, extinguished the light of phosphorus shining in common air. The vapour of alcohol, of camphor, and even of assafœtida at ordinary temperatures, has had the same effect. Phosphorus even fuses in the vapour of camphor without becoming luminous; and may even be sublimed with camphor without inflaming. The mixed sublimate of phosphorus and camphor exposed to the air on the warm hand, did not shine till rubbed, when it became brilliantly luminous. Phosphorus may also be boiled in and distilled from oil of turpentine without inflaming.

Though phosphorus inflames in pure chlorine gas, its light is extinguished when it is exposed to the vapour of chlorine, as when it is held over an aqueous solution of this substance. The same happens when it is exposed to the vapour of Iodine and Bromine.

It does not shine in nitrous oxide, though mixed with common air. When heated in this gas it melts, and at the subliming point decomposes the gas explosively with a bright flash. Its light is extinguished by nitrous acid gas or vapour, even when so much diluted with common air as hardly to be perceptible by the sense of smell.

The vapour of ammonia, of muriatic acid, of distilled vinegar, and of hydrocyanic acid, do not appear to prevent phosphorus from shining; they rather increase the brightness of its light. It shines in carbonic acid gas, and muriatic acid gas, when the minutest quantity of atmospheric air is present.

It appears to be soluble, or capable of rising in vapour in muriatic acid gas, carbonic acid gas, and hydrogen gas; for when these gases perfectly pure have been kept some time over mercury with phosphorus in them, a luminous appearance has been produced (bright flashes of diffused light), when they have been passed alone into a jar of common air. The same effect takes place, when the azote of atmospheric air, deprived of its oxygen by the *slow* action of phosphorus, is thrown into the at-

mosphere, or into oxygen gas. But the reverse is the case, when the oxygen of the atmospheric air has been separated by *intense* combustion; however much the phosphorus has been in excess, and though it has been a second time sublimed in the azote, it has not acquired the power of shining on admixture with common air, although from its smell there was no reason to suppose that the gas did not contain phosphorus in solution.

Mr. Graham has pointed out the remarkable effect of different varieties of carburetted hydrogen in extinguishing the light of phosphorus. The results of my experiments with these gases perfectly agreed with his. I have also found that hydrogen gas obtained from iron-filings and dilute sulphuric acid (the former from the blacksmith's shop) has had a similar extinguishing effect, though in a less degree. One volume of it, mixed with fifty-nine of common air, has prevented phosphorus immersed from shining; diluted more than this, it lost its preventive power. This result is probably owing either to the presence of a little vapour somewhat analogous to that of naphtha, on which the odour of hydrogen gas thus procured depends (and the odour of this gas was strong); or, on the presence of a little carburetted hydrogen formed by the union of the nascent hydrogen and the carbon of the cast-iron or steel at the instant of separation. The result of the analysis of the gas by the explosion with oxygen by means of the electric spark, has been rather favourable to the first supposition; but the quantity of carbonic acid gas formed was so extremely small, that it was impossible to decide positively. The fact that hydrogen gas procured by means of very pure steel, such as piano-forte wire, does not, when mixed with atmospheric air, extinquish the light of phosphorus, is favourable to the same conclusion.

Some of the results described are not without interest in relation to practical chemistry. Mr. Graham has pointed out the applicability of phosphorus to detect in mixed gases the presence of very minute quantities of carburetted hydrogen. It is equally applicable as a test of the purity of muriatic acid gas and carbonic acid, and hydrogen gas. If they contain the slightest trace of common air, phosphorus will shine in these gases, provided they are otherwise unadulterated. It has been shown how it is capable of detecting an adulteration of hydrogen, which had hitherto, I believe, escaped detection; and, it may also be employed to detect similar impurities in other gases, in which, with an admixture of common air, phosphorus usually shines. I need not point out the caution that is required in deciding on the absence of oxygen, in any mixed gas in which phosphorus does not become luminous.

In relation to the results in general, they are not without some interest theoretically considered, as belonging to the more obscure phenomena of chemistry, somewhat analogous to what we witness in the animal and vegetable kingdoms, in which notable changes,

during life and after death are taking place, owing to the action of causes which we are not able to appreciate, or perhaps of substances which have hitherto eluded detection.*

ON HOLDING THE BREATH FOR A LENGTHENED PERIOD.

By Michael Faraday, Esq. D. C. L. F. R. S. &c., Fullerian Professor of Chemistry in the Royal Institution.

At one of the scientific meetings at the apartments of His Royal Highness the President of the Royal Society, whilst speaking of certain men, who, by means of peculiar apparatus for breathing, could walk about at the bottom of waters, and also of the pearl fishers, Sir Graves C. Haughton described to me an observation he had made, by the application of which a man could hold his breath about twice as long as under ordinary circumstances. It is as follows:—If a person inspire deeply, he will be able immediately after to hold breath for a time, varying with his health, and also very much with the state of exertion or repose in which he may be at the instant. A man, during an active walk, may not be able to cease from breathing for more than half a minute, who, after a period of rest on a chair or in bed, may refrain for a minute or a minute and a half, or even two minutes. But if that person will prepare himself by breathing in a manner deep, hard, and quick, (as he would naturally do after running,) and, ceasing that operation with his lungs full of air, then hold his breath as long as he is able, he will find that the time during which he can remain without breathing will be double, or even more than double the former, other circumstances being the same. I hope that I have here stated Sir Graves C. Haughton's communication to me correctly; at all events whilst confirming his observation by personal experience, I found the results to be as above.

Whilst thus preparing myself, I always find that certain feelings come on resembling, in a slight degree, those produced by breathing a small dose of nitrous oxide; slight dizziness and confusion in the head are at last produced; but on ceasing to breathe, the feeling gradually goes off, no inconvenience results from it either at the time or afterwards, and I can hold my breath comfortably for a minute and a quarter, or a minute and a half, walking briskly about in the mean time.

Now this effect may be rendered exceedingly valuable. There are many occasions on which a person who can hold breath for a minute or two minutes, might save the life of another. If, in a brewer's fermenting vat, or an opened cesspool, one man sinks senseless and helpless, from breathing the unsuspected noxious atmosphere within, another man of cool mind would by means of this mode of preparation, which requires nothing but what is

* Jameson's Journal.

always at hand, have abundant time, in most cases, to descend by the ladder or the bucket, and rescue the sufferer without any risk on his own part. If a chamber were on fire, the difference in the help which could be given to any one within it by a person thus prepared, and another who goes in, perhaps, with lungs partially exhausted, and who, if he inhale any portion of the empyreumatic vapours of the atmosphere, is stimulated to inspire more rapidly, and is, therefore, urged to instant retreat into fresh air, is so great, that no one who has noticed what can be done in a minute or in two minutes of time can doubt the value of the preparation under such circumstances, even though from want of practice and from hurry and alarm it may be very imperfectly made. In cases of drowning, also, a diver may find his powers of giving aid wonderfully increased by taking advantage of Sir Graves Haughton's fact.

I have myself had occasion to go more than once or twice into places with atmospheres rendered bad by carbonic acid, sulphuretted hydrogen or combustion; and I feel how much I should have valued at such times the knowledge of the fact above stated. Hoping, therefore, that it may be useful, I will add one or two precautions to be borne in mind by those who desire to apply it.

Avoid all unnecessary action; for activity exhausts the air in the lungs of its vital principle more quickly, and charges it with bad matter. Go collectedly, coolly and quietly to the spot where help is required; do no more than is needful, leaving what can be done by those who are in a safe atmosphere (as the hauling up of a senseless body, for example,) for them to do.

Take the precautions usual in cases of danger in *addition* to the one now recommended. Thus, in a case of choke-damp, as in a brewer's vat, hold the head as high as may be; in a case of fire in a room, keep it as low down as possible.

If a rope is at hand, by all means let it be fastened to the person who is *giving* help, that he may be succoured if he should venture too far. It is astonishing how many deaths happen in succession in cesspools, and similar cases, for want of this precaution.

It is hardly needful to say, do not try to breathe the air of the place where help is required. Yet many persons fall in consequence of forgetting this precaution. If the temptation to breathe be at all given way to, the *necessity* increases, and the helper himself is greatly endangered. Resist the tendency and retreat in time.

Be careful to commence giving aid with the lungs *full* of air, not *empty*. It may seem folly to urge this precaution, but I have found so many persons who, on trying the experiment on which the whole is based, have concluded the preparation by closing the mouth and nostrils *after an expiration*, that I am sure the precaution requires to be borne in mind.

I have thought it quite needless to refer to the manner in which the preparation enables a person to increase so considerably the time during which he may suspend the operation of breathing. It consists, of course, chiefly in laying up for the time, in the cells of the lungs, a store of that vital principle which is so essential to life. Those who are not aware of the state of the air in the lungs during ordinary respiration, and its great difference from that of the atmosphere, may obtain a clearer notion from the following experiment. Fill a pint or quart jar with water over the pneumatic trough, and with a piece of tube and a forced expiration throw the air from the lungs in their *ordinary state* into the jar; it will be found that a lighted taper put into that air will be immediately extinguished.

A very curious fact connected with the time of holding the breath was observed by Mr. Brunel, jun., and has, I think, never been published. After the river had broken into the tunnel at Rotherhithe, Mr. Brunel descended with a companion (Mr. Gravatt, I think), in a diving-bell, to examine the place: at the depth of about 30 feet of water, the bell touched the bottom of the river, and was over the hole; covering it, but too large to pass into it. Mr. Brunel, after attaching a rope to himself, inspired deeply, and sunk, or was lowered through the water, in the hole, that he might feel the frames with his feet, and gain further knowledge, if possible, of the nature of the leak. He remained so long beneath without giving any signal, that his companion, alarmed, drew him up before he desired; and then it was found that either of them could remain about twice as long under water, going into it from the diving-bell at that depth, as they could under ordinary circumstances.

This was supposed to be accounted for, at the time, by the circumstance that at the depth of 30 feet the atmosphere was of double pressure, and that the lungs, therefore, held twice as much air as they could do under common circumstances. It is, however, quite evident that another advantageous circumstance must have occurred, and that the air in the lungs was also better in quality than it would have been at the surface of the river, as well as denser; for supposing the deterioration by breathing to continue the same for the same time, it is clear that every inspiration passed into the lungs twice as much pure air as would have entered under common circumstances: the injured air must, therefore, have been removed more rapidly, and the quality of that at any one time in the lungs must have risen in consequence. When to this is added the effect of double quantity, it fully accounts for the increased time of holding the breath; and had the effect of the mode of preparation now described been also added, it is probable that the time would have appeared astonishingly increased.*

* Philosophical Magazine.

GAS-MAKING.

Messrs Dickson and Ikin have patented the following improvements in the process of making gas from coals or other substance. Their invention consists of three improvements in the apparatus and process of making gas. *First*, in the manner of setting the retorts and means of applying the fuel. *Secondly*, in a mode of cooling, condensing, and purifying the gas by absorption in a vacuum; and, *Thirdly*, in a manner of producing a vacuum to the apparatus connected to the retorts whereby such apparatus and retorts are not subject to pressure.

First, of the setting the retorts. The patentees state the common way of heating retorts is to keep a small quantity of fuel in a high degree of combustion, and by the assistance of a chimney or other means, a strong draught or current of heated air and flame is caused to pass in various directions amongst and against the retorts which are placed in what is called an oven or furnace, and in this oven or furnace brickwork or other guards are generally placed between the fire and retorts to save them from the intense destructive heat, and to disperse the flame and current of heated air. Now the object of the first improvement is to keep a large quantity of fuel in a low degree of combustion and closely shut up in a chamber of brickwork or other materials, which chambers are called kilns. In these kilns the retorts of any shape or size are placed in any position in immediate contact with and surrounded on all sides by the fuel which heats them; consequently these retorts will generally have the same degree of temperature as the ignited fuel that touches them, and this heat is regulated by the admission of atmospheric air through holes or openings, having doors or dampers for regulating such admission. By this improvement the patentees state, that the operation of distilling gas may be conducted without the aid or use of a chimney, and by only burning coke, or cinders, and thus obtaining a considerable saving in fuel. The drawing attached to the specification represents ten retorts set in brick-work, leaving a space all around, which is filled up with coke, closely in contact with all parts of the retorts, which, when lighted, becomes one mass of fire, and the same may be kept at a regular temperature, by means of the quantity of atmospheric air admitted. By this improvement the patentees conceive that a great saving will be effected, particularly in fuel, as the object is to use coke in the place of coal, whilst, at the same time, the retorts not being subject to violent drafts, and consequent unequal action of the fire, will not be so quickly destroyed. The second improvement relates to the purifying and condensing of gas in a vacuum. This improvement is applied after the gas has passed the hydraulic main, and has consequently deposited its coal tar and ammoniacal liquor in the ordinary way. It should be observed, that the ordinary mode of cooling, condensing, and purifying gas, is, by

causing it to traverse a succession of vessels or pipes, varying in length to upwards of 1,500 feet, which are sometimes exposed to the atmosphere, and sometimes placed under ground, but more frequently surrounded by water, from thence the gas passes through, and is washed by water, and is also passed through beds or layers of lime, in the common lime vessels, or purifiers, which causes considerable strain or pressure to the retorts, and other parts of the apparatus. The object of the improvement in this part of the apparatus is to carry on the process of gas-making, without causing such pressure to the apparatus, the gas is permitted to flow freely through the hydraulic main to the gasometer, and, at the same time, is brought into immediate contact with water, in the form of showers, streams, or jets ; and as ammonia and water have a great affinity for each other, the ammonia will be taken up by the water; and if there be an admixture of lime, the sulphur will also be separated from the gas. The apparatus for effecting this part of the invention consists of a vessel, having a succession of shelves, which are perforated with holes, down and through which the water runs in streams ; and the shelves being placed alternately, from side to side, and sloping downwards, the water is continually changing its course, as it flows downwards, and the gas being admitted at the lowest parts rises in an opposite direction, and is constantly acted on by the water, and is thus condensed and purified. There are also perforated shelves containing lime, through which the gas passes, the more perfectly to accomplish the purification. This second improvement is said to be greatly facilitated by the action of the third improvement,—that of a means of producing a vacuum to the parts described; and this consists in attaching a pipe from the upper part of the last described vessel to an apparatus somewhat similar to a SAVARY'S steam engine. The first cylinder is to be full of water, which is forced from this cylinder into the second cylinder, by the pressure of steam, and when the first cylinder becomes full of steam, and the other full of water, the steam cock is closed, and the gas cock from the purifier and condenser last described, and which is connected to the second cylinder, is opened by this means, as the steam becomes condensed in the first cylinder, the water flows back, and the gas fills the space left by the water in the second cylinder; the steam cock is then again opened, which drives the water from the first into the second cylinder, and thus the gas is driven forward out of the second cylinder to the gasometer, and this action is constantly kept up during the production of gas.

The patentees claim the three improvements above mentioned; that is, the heating retorts (in the distillation of gas from coal or other material) by placing them in contact with, and surrounded by, the fuel, without the aid of a high chimney or other means of obtaining a violent draft; also the means of purifying gas; and the means of aiding the operation by an apparatus for producing

a vacuum, thereby avoiding the pressure otherwise consequent on the retorts and other parts of the apparatus when used in the ordinary manner.*

ANALYSIS OF CARMINE.

This is the colouring principle of cochineal, and was first obtained in a separate state by Pelletier and Caventou, in 1808. Carmine, procured by the process described by these authors in their original paper, was subjected to analysis after being dried *in vacuo*, and at a moderate heat, to deprive it of all traces of alcohol and æther. Its composition was determined by burning with per-oxide of copper. It yielded

	by direct Analysis.	Atomic Composition.	Calculated Results.
Carbon	49·33	16	49·43
Hydrogen	6·66	26	6·65
Azote	3·56	1	3·57
Oxygen	40·45	10	40·42

M. Pelletier expresses, however, some doubt as to the true composition of carmine, and thinks it possible that the specimen analyzed contained some water.†

CHEMICAL DECOMPOSITION BY COMMON ELECTRICITY.

By Michael Faraday, D. C. L. F. R. S., &c.

The chemical action of voltaic electricity is characteristic of that agent, but not more characteristic than are the laws under which the bodies evolved by decomposition arrange themselves at the poles. Dr. Wollaston showed‡ that common electricity resembled it in these effects, and "that they are both essentially the same;" but he mingled with his proofs an experiment having a resemblance, and nothing more, to a case of voltaic decomposition, which however he himself partly distinguished; and this has been more frequently refered to by others, on the one hand, to prove the occurrence of electro-chemical decomposition, like that of the pile, and on the other, to throw doubt upon the whole paper, than the more numerous and decisive experiments which he has detailed.

I take the liberty of describing briefly my results, and of thus adding my testimony to that of Dr. Wollaston on the identity of voltaic and common electricity as to chemical action, not only that I may facilitate the repetition of the experiments, but also lead to some new consequences respecting electro-chemical decomposition.

I first repeated Wollaston's fourth experiment,§ in which the

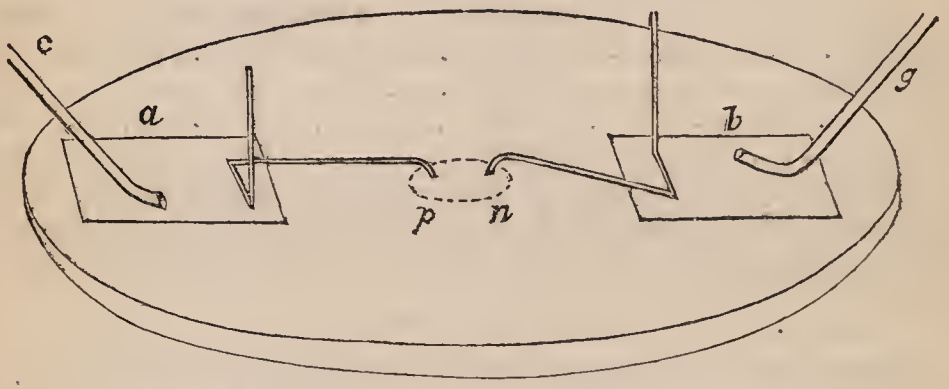
* Repertory of Arts.

† M. Pelletier, in Les Annales de Chimie.

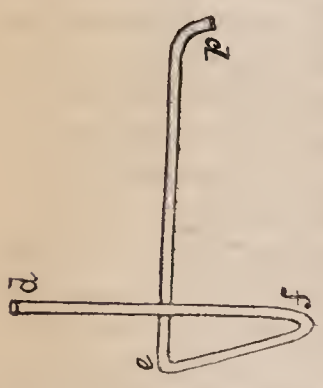
‡ Phil. Trans. 1801, pp. 427, 434. § Ibid. 1801, p. 429.

ends of coated silver wires are immersed in a drop of sulphate of copper. By passing the electricity of the machine through such an arrangement, that end in the drop which received the electricity became coated with metallic copper. One hundred turns of the machine produced an evident effect; two hundred turns a very sensible one. The decomposing action was, however, very feeble. Very little copper was precipitated, and no sensible trace of silver from the other pole appeared in the solution.

A much more convenient and effectual arrangement for chemical decompositions by common electricity, is the following. Upon a glass plate, fig. 2, placed over, but raised above a piece of white paper, so that shadows may not interfere, put two pieces of tinfoil *a*, *b*; connect one of these by an insulated wire *c*, or wire and string, with the machine, and the other *g*, with the discharging train, or the negative conductor; provide two



pieces of fine platina wire, bent as in fig. 3, so that the part *d*, *f* shall be nearly upright, whilst the whole is resting on the three bearing points *p*, *e*, *f*; place these as in fig. 2; the points *p*, *n* then become the decomposing poles. In this way surfaces of contact, as minute as possible, can be obtained at pleasure, and the connexion can be broken or renewed in a moment, and the substances acted upon examined with the utmost facility.



A coarse line was made on the glass with solution of sulphate of copper, and the terminations *p* and *n* put into it; the foil *a* was connected with the positive conductor of the machine by wire and wet string, so that no sparks passed: twenty turns of the machine caused the precipitation of so much copper on the end *p*, that it looked like copper wire; no apparent change took place at *n*.

A mixture of half muriatic acid and half water was rendered deep blue by sulphate of indigo, and a large drop put on the glass, fig. 2, so that *p* and *n* were immersed at opposite sides: a single turn of the machine showed bleaching effects round *p*, from evolved chlorine. After twenty revolutions no effect of the kind was visible at *n*, but so much chlorine had been set free at *p*, that when the drop was stirred the whole became colourless.

A drop of solution of iodide of potassium mingled with starch was put into the same position at *p* and *n*; on turning the machine, iodine was evolved at *p*, but not at *n*.

A still further improvement in this form of apparatus consists in wetting

a piece of filtering paper in the solution to be experienced on, and placing that under the points *p* and *n*, on the glass: the paper retains the substance evolved at the point of evolution, by its whiteness renders any change of colour visible, and allows of the point of contact between it and the decomposing wires being contracted to the utmost degree. A piece of paper moistened in the solution of iodide of potassium and starch, or of the iodide alone, with certain precautions, is a most admirable test of electro-chemical action; and when thus placed and acted upon by the electric current, will show iodine evolved at *p* by only half a turn of the machine. With these adjustments and the use of iodide of potassium on paper, chemical action is sometimes a more delicate test of electrical currents than the galvanometer. Such cases occur when the bodies traversed by the current are bad conductors, or when the quantity of electricity evolved or transmitted in a given time is very small.

A piece of litmus paper, moistened in solution of common salt or sulphate of soda was quickly reddened at *p*. A similar piece moistened in muriatic acid was very soon bleached at *p*. No effects of a similar kind took place at *n*.

A piece of turmeric paper, moistened in solution of sulphate of soda, was reddened at *n* by two or three turns of the machine, and in twenty or thirty turns plenty of alkali was there evolved. On turning the paper round, so that the spot came under *p*, and then working the machine, the alkali soon disappeared, the place became yellow, and a brown alkaline spot appeared in the new part under *n*.

On combining a piece of litmus with a piece of turmeric paper, wetting both with solution of sulphate of soda, and putting the paper on the glass, so that *p* was on the litmus and *n* on the turmeric, a very few turns of the machine sufficed to show the evolution of acid at the former and alkali at the latter, exactly in the manner effected by a volta-electric current.

All these decompositions took place equally well, whether the electricity passed from the machine to the foil *a*, through water, or through wire only; by *contact* with the conductor, or by *sparks* there; provided the sparks were not so large as to cause the electricity to pass in sparks from *p* to *n*, or towards *n*; and I have seen no reason to believe that in cases of true electro-chemical decomposition by the machine, the electricity passed in sparks from the conductor, or at any part of the current, is able to do more, because of its tension, than that which is made to pass merely as a regular current.*

TWO CHLORIDES OF SULPHUR.

THENARD AND GAY LUSSAC have made a very favourable report, on the memoir of Dumas on this subject.

Chemists have hitherto recognised but one combination of sulphur with chlorine, although the compounds of these elements present themselves under different aspects, some red and some yellow. M. Rose indeed suspected that the red owed its colour to an excess of chlorine, but his hypothesis was supported by no fact. Dumas conceived that the two kinds were distinct compounds, and to be certain of it, he subjected them to a rigorous

* Philosophical Magazine.

analysis, having obtained both the red and the yellow chloride of a high degree of purity. He has accordingly proved that the yellow kind is a protochloride, composed of one atom of sulphur, and one atom of chlorine, and that the red is a bichloride, formed of one atom of sulphur and two atoms of chlorine.*

PREPARED CHARCOAL FILTER.

M. DUMONT, an experienced manufacturer of beet sugar, has invented a filter, and a prepared charcoal, for the bleaching of sirups; of which MM. Serullas Bussy and Derosne have reported as follows to the *Societie de Pharmacie de Paris*.

The discovery of the decolorizing property of charcoal, is due to Lowitz of St. Petersburgh, who however did not remark the difference in activity between vegetable and animal charcoal. Therefore, the former only was employed in the sugar refineries for the decoloration of sirup. In 1811, M. Figuier, of Montpellier, ascertained that animal charcoal was superior, and employed it to remove the colour of wine, vinegar, and the residuum of sulphuric ether. We cannot ascertain from his published memoir that he applied it to sirups. It was a year later that M. Charles Derosne introduced it into the sugar refineries and manufactories of beet sugar, thus rendering great service to these two branches of national industry, and, perhaps, a greater to the manufacturers of sal ammoniac, who, until that time, had thrown away as useless, all the residuum of their distillations. Since that period, the consumption of animal charcoal has been continually increasing, and its manufacture has become a source of considerable revenue. Its mode of use underwent little change. After pulverization and mixture with the sirup to be decolorized, this was boiled and passed through a woollen cloth; by these means its full action was thought to have been attained, and we could not have imagined the possibility of the great improvements in the manner of its employment which M. Dumont has recently introduced.

This manufacturer, reflecting upon the diffidulties of the old process not only in the use of the charcoal, but also in the washing of the residue, and upon the foreign taste acquired by the sirup during ebullition, with that agent sought to remedy them all, and has completely succeeded. His discovery comprises the preparation of the charcoal, and its employment by means of a filter of his own invention. The preparation of the charcoal is very simple; it consists in reducing it to grains of equal bigness with those of sporting gunpowder, and removing the dust; these grains, however, vary in size with the density of the sirup to be bleached.

The filter of M. Dumont is a truncated pyramid turned base upward, made of wood, and lined throughout with tinned copper. At the lower part is a spigot for drawing off the sirup, a little above that an opening, communicating with a tube external to the filter, and used for removing the air of the apparatus. The filter is furnished with two diaphragms of different sizes. When a sirup is to be filtered, the small diaphragm is to be placed on the bottom of the filter resting upon four feet, elevating it higher than the spigot and opening of the air-tube. Upon this diaphragm a piece of coarse cloth is to be extended, and upon it the charcoal previously moistened with one-sixth of its weight of water, is to be placed in

* Rev. Encyclopædia.

such a manner that all parts shall be equally furnished. The level surface receives another coarse cloth and the larger diaphragm upon which the sirup is to be poured. By this arrangement the effusion of the sirup occasions no derangement of charcoal, and the irregular flow of the liquid is prevented. The sirup, in percolating the beds of charcoal, displaces the water with which that article was moistened, and forces it out at the spigot, where it may be received until it is ascertained that its place has been supplied by sirup, which soon flows in an uninterrupted stream, to be kept up by renewed additions upon the filter. If the charcoal be not wetted with water, the sirup will have more difficulty in penetrating its substance, it may pass more in one part than another, and the filtration will not proceed regularly. Besides, the water acts another part when animal charcoal is employed, that is, in lixivating (in a partial manner at least) that article, which may be recognised by the salt taste which it acquires.

M. Dumont made a trial of his filter in our presence with a sirup from raw sugar. The experiment was successful, and we present you with the product numbered in the order of their flowing; the sirup No. 1, is almost colourless. No. 2, of a light amber colour. No. 3, a shade darker. By mixing these in equal proportions, a sirup, equal to that from good clayed sugar, was produced. The purity of taste forms an additional recommendation to these sirups, the flavour of raw sugar being entirely removed. We made a comparative trial of charcoal in the same proportion, by the old process, and upon the same kind of raw sugar, but the product did not approach the beauty of that obtained by M. Dumont's filter, its colour was darker than that of No. 3, and in the taste there was still greater difference, from the sirup having acquired a disagreeable flavour by ebullition with the charcoal. For the decoloration of sugar, M. Dumont employs twenty-five per cent of charcoal. This will certainly appear to be a large proportion, but we would observe, that after the first operation, the charcoal retains much of its decolorizing property. Sirup, equal in quantity to the first, may be poured in, and will lose three-fourths of its original colour; in fact, it will be bleached more than if we had treated the same quantity of sugar with twelve per cent. of charcoal, in the ordinary way.

M. Dumont's filters are of different sizes. The small contain from twelve to fifteen pounds of charcoal, and the large as much as two hundred pounds. By them, sirups of all densities, from the least to the greatest, may be filtered.

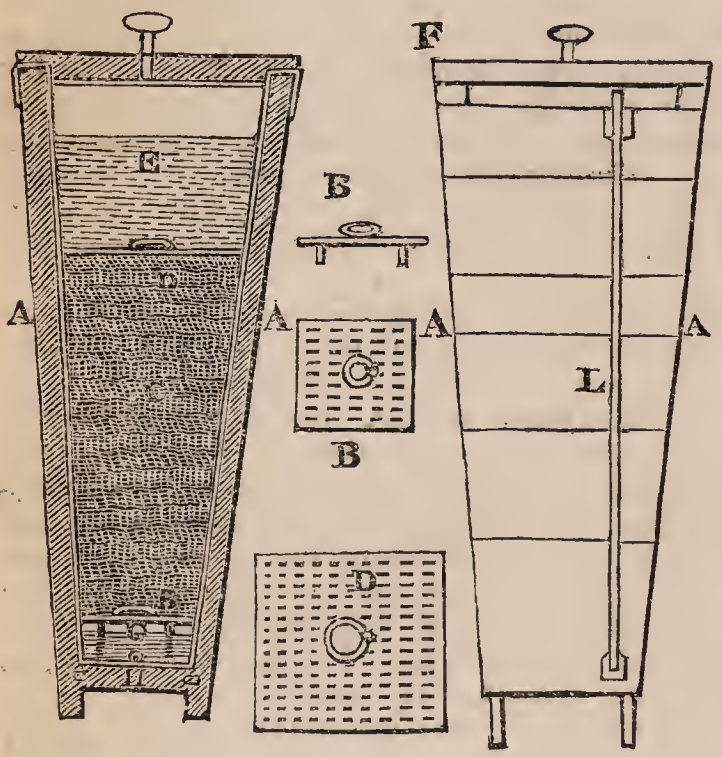
Sirup of 28° to 30° of the areometer filters very well cold, those of 36° to 38° require to be poured in hot, and the charcoal coarser, as before stated, the operation lasts about the same time, but the product is not so well decolorized.

The sirup of twelve hundred pounds of sugar can be filtered in twenty-four hours.

With regard to the superiority, in point of taste, of the sirups filtered by M. Dumont, over those which have been boiled with charcoal, it is much more easily to be comprehended, it being an incontestable fact, that animal charcoal imparts to sirups with which it is heated, a disagreeable flavour;—a flavour which increases with the proportion of charcoal.

M. Dumont estimates the results obtained by his process as four times greater than by the old, and assures us that his decolorized sirups are enhanced 30 per cent. in value. Were it even necessary to abate somewhat of these valuations, it is not the less certain that his process will secure

great benefits to those who employ it. Already some pharmaciens have adopted it, and it is used by confectioners and distillers. We know that a director of one of the largest sugar refiners in Paris, has commenced its trial, and every thing induces the belief that he will have reason to congratulate himself upon the experiment.*



The ready employment of M. Dumont's filter, and the good quality of the sirups obtained whether for consumption in that state or for crystallization; the simplicity and promptitude of the washing, induce us to believe that his process will effect marked changes in the arts connected with the manufacture and refining of sugar.

A A, wooden box lined with tinned copper. B, lower diaphragm pierced with holes and supported upon four feet; it is movable. C, space for charcoal. D, upper diaphragm, (movable.) E, space for the coloured sirup. F, wooden cover lined with copper. G, space into which the decolorized sirup flows. H, spigot. K, opening to which the tube L is adapted, giving passage to the air.

N.B. The sirups must be clarified and perfectly limpid before being poured upon the charcoal. This condition is essential to the success of the operation.†

HISTORY OF GAS-LIGHTING.

At a meeting of the Society of Arts, a paper was read by Mr. Aikin on the gaseous substances used for artificial light and the manufacture of gas. In our notice of this *illustration* we must be very brief. The practical details of the manufacture of gas, with descriptions of the retorts, tubes, tanks, hydraulic-mains, &c. without the drawings, the exhibition of which accompanied Mr. Aikin's discourse, would be uninteresting to the most acute reader. The application of elastic fluid, or gas, to the purpose of affording artificial light is of modern invention, though from

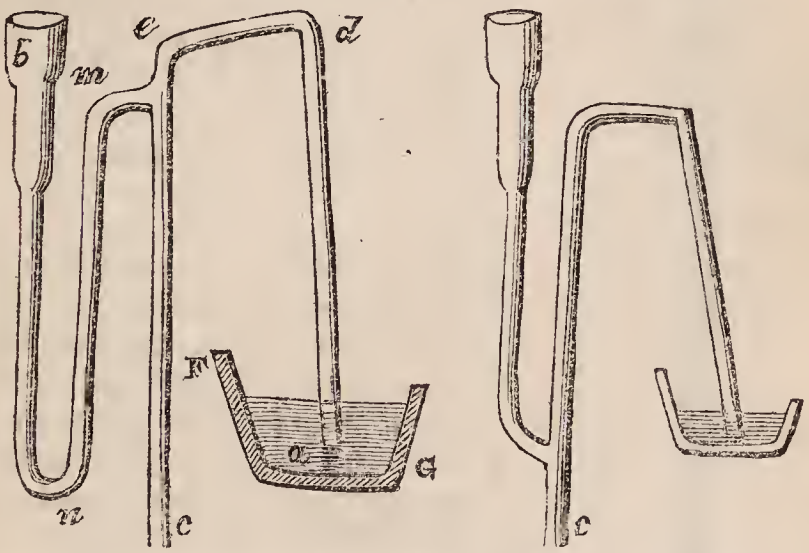
* In another number of the Journal de Pharmacie is the following:—"The use of the filter and animal charcoal to which he (M. Dumont) gives a particular preparation, has already enabled several manufacturers to vend domestic sugar of superior quality to any heretofore made."

† Silliman's Journal.

an early period its existence was acknowledged; for what is the blaze of a coal fire but the burning of coal-gas? In 1739, a Fellow of the Royal Society first discovered the inflammable nature of coal-tar; in 1746, farther advances were made; and, some time after, the Earl of Dundonald obtained a patent for the manufacture of gas and coke; but it may be fairly said, that until its introduction by Mr. Windsor, who lighted what was then the Lyceum theatre in the Strand, and one side of Pall-mall, with gas, the extent of its usefulness as an artificial light was not understood. A chaldron of coal, after remaining about eight hours in the retort, yields from 10,000 to 14,000 cubic feet of gas, the difference in quantity arising from the quality of the coal; a loss, varying from 22½ to 34½ per cent., takes place, and it becomes coke. About one cwt. of tar is also extracted, together with a quantity of ammoniacal liquor, from which is made sal ammoniac, and other chemical compounds.*

GLASS SYPHONS FOR TRANSFERING CORROSIVE FLUIDS.

M. Collardeau has designated the form of a glass syphon, which saves the necessity of applying the mouth or even the finger to either end of the tube. Dip the end *a* of fig. 1. into the fluid to be transfered, and pour into the funnel or side opening *b*, a quantity of the same fluid, until it flows out of the end *c*. The fluid in the vessel F. G., then rises and continues through *a d e c*. In this case, the branch *m n* remains full, while the liquid in *b n* subsides to near the bend *n*.



The same object is effected by the more simple form of fig. 2., provided the opening *c* is closed with a finger until the long branch of the syphon is full,—or, the application of the finger is unnecessary if the fluid be poured into the funnel faster than it can be discharged through *c*. In that case, the long branch of the syphon will fill and then act in the usual way.†

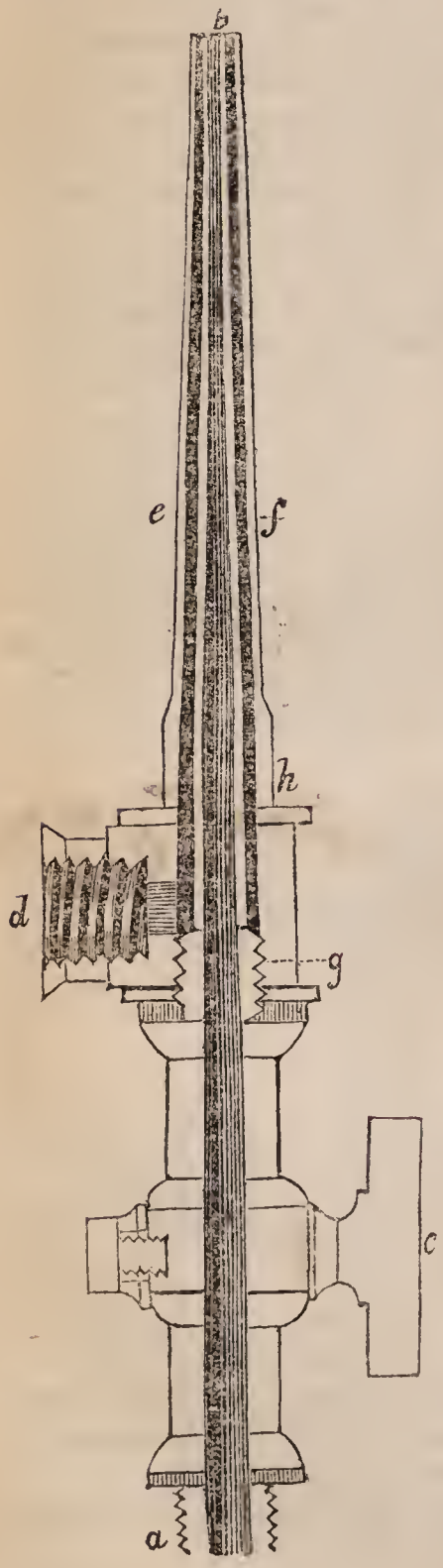
* Repertory of Arts.

† From the French, quoted in Silliman's Journal.

NEW OXY-HYDROGEN JET.

By J. F. Daniell, Esq. F.R.S. Prof. Chem. King's College, London.

ANNEXED is the representation of a jet for the combustion of any inflammable gas with oxygen, which Mr. Daniell has found extremely useful, both in original research, and in commodiously exhibiting a variety of instructive class experiments.



The cut represents it in section:—*a b* is a jet of brass, to be connected, by means of the stop-cock *c*, and a flexible pipe, with a gas-holder of oxygen gas. This is fixed by means of a screw *g*, in the centre of another jet *e f*, and connected by means of the lateral arm and screw *d*, with another gas-holder of hydrogen gas; or with, what is better still, the pipe of a coal-gas burner. The second jet thus forms an exterior coating to the first; and when the inflammable gas flows through it, and is ignited at the orifice, a stream of oxygen may be directed into the interior of the flame by means of the latter with any required degree of force.

All the effects of the oxy-hydrogen blowpipe may thus be produced with the greatest convenience and safety; and that upon a scale which it would not be prudent to adopt with that instrument. When coal-gas is used, the change in the colour of the flame indicates with great precision the exact amount of oxygen which is sufficient to insure perfect combustion; and by these means is readily effected the fusion of 100 grains of clippings of platinum into a perfect button, with an expense of less than three pints of oxygen gas. The aperture of the jet did not become, during the process, hotter than the hand could bear. The combustion of the gases is thus rendered so extremely manageable and economical, that by the proper arrangement of three or four such jets, the waste cuttings of platinum which are formed during the working of that metal, and which at present can only be worked up by redissolving them in

acid, might be readily melted together, and applied to profitable use. I have succeeded in melting together a considerable quantity of the grains of crude platinum, after digestion in nitric acid; but the button was perfectly brittle under the hammer.

By placing the end of the jet *b h* within a lantern provided with a parabolic reflector, and exposing to the flame upon a pin of platinum a small fragment of lime, Mr. Daniell succeeded perfectly in exhibiting the beautiful experiment of Lieut. Drummond's light; and can produce a prismatic spectrum almost equal in brilliancy to the solar. By concentrating the rays of light from the same source by means of the lenses of a solar microscope, phosphorus may be inflamed, and chloride of silver blackened; affording a beautiful illustration of the conversion of heat, *which will not pass through glass* into heat *which will pass through glass*, with all the properties of solar heat, by the radiating power of a solid undergoing no chemical change whatever.

The same jet when supplied with common air from the gas-holder, instead of oxygen gas, serves the purposes of a very convenient blowpipe.*

GELATINE FROM BONES.

THE following are the results from the employment of gelatine from bones, continued without interruption at the hospital of St. Louis, during three years and three months, by Monsr. D'Arcet.

The apparatus employed at the hospital of St. Louis for extracting the gelatine from bones has been in full activity since the 9th of October, 1829: since that time, that is, for three years and three months, it has wrought night and day without interruption, and has supplied in that space of time 1,059,701 rations of gelatinous solution, and 2,192 kilogrammes (4,384lbs. of grease.

All this gelatinous solution has been used in the hospital, either in the preparation of broth, or mixed with vegetable nourishment: all the grease has served instead of butter, in preparing the vegetables or ragouts that have been distributed among the sick and labourers; and thus they have received better broth and ragouts than indifferent "*bouilli.*" (The meat from which broth or soup is made.)

Since the hospital of St. Louis has adopted the use of aliment from gelatine, 21,430 sick and work-people have in that time been supported by it; and, for the last two years, the governors have besides ordered the distribution every Sunday of 75 rations of soup and gelatine to the poor of the district.

More than 29,000 persons, therefore, in the course of three years and three months have been supplied at the hospital of St. Louis with more than a million of rations of gelatine.

To this may be added that the sick, labourers, and poor are

* Philosophical Magazine.

perfectly satisfied with the regimen adopted at the hospital, and would not revert, without complaint and opposition, to the ordinary mode of living.*

SULPHATE OF QUININE.

M. M. Pelletier and Desprez have patented the following improvements in manufacturing sulphate of quinine.

Their principal object is, the production of sulphate of quinine, by means of distilled or compressed oils, whether derivable from vegetable, animal, or mineral substances, or matter as a substitute for, and without the aid of, alcohol. Where distilled oil is intended to be used, the bark having been treated by acids, and having precipitated the quinine and the other dissoluble matters in the acid, by means of lime, in the usual method used in making quinine, the calcarious precipitate is to be dried, and reduced to a fine powder; it is then treated several times, say seven or eight, with the oil intended to be used; and from experience turpentine oil has been found to answer the best, which is done in appropriate vases, or other fit vessels found best calculated to answer the object. The oil is then to be separated by decantation or filtration. Where expressed oil is used, care must be taken that the lime be first extracted, otherwise a soap of lime insoluble would be formed. The precipitate must then be dissolved in an acid, and the rough quinine be precipitated by ammonia; when in this state, it must be treated with oil several times, which will dissolve the quinine, and separate from it all matters foreign to the same. After obtaining the quinine in dissolution, by expressed or distilled oils, the oil is to be treated by water acidulated with any acid capable of forming a soluble salt with the quinine (hydrochloric acid is preferable); the acidulated water separates the quinine from the oil, the separation being easily effected by decantation, as the two liquids, having different specific weights, will not combine. The quinine thus dissolved, is to be precipitated by an alkali, and after that, it is reduced to sulphate by uniting it to sulphuric acid, care being taken to saturate and whiten by animal charcoal; it is then crystallized by the method usually adopted. There is another mode of separating the quinine when dissolved in distilled oils; this mode is by application of heat in any of the known ways used in the separation of liquids; but the process is considered less advantageous, and the patentees therefore prefer treating the oil by acidulated water.†

METEORIC IRON.

Professor Stromeyer, Foreign Member R.S., has presented to the Society, two specimens, one of the coarse-grained, the

* Repertory of Arts. † Ibid.

other of the fine-grained variety, of the remarkable mass of iron lately discovered near Magdeburg, and an account of which had a short time previously been before the Royal Society of Gottingen. This iron was found, in several detached lumps, about four feet below the mould, by Mr. Kote, who considered himself the more authorized to pronounce it meteoric, as, in the chronicles of Magdeburg, the descent of a fiery meteor is recorded as having happened in the year 998.* Professor Stromeyer has subjected this iron to a minute analysis, the results of which are very interesting, inasmuch as, besides the alloy of nickel and cobalt, usually present in meteoric iron, he unexpectedly found a considerable portion of molybdenum,—a rare metal on our planet, occurring only in two combinations, viz. with sulphur, as glance molybdenum, and, as molybdic acid combined with oxide of lead, in the yellow lead ore of Carinthia and a few other places. (See Philosophical Magazine, vol. iii., No. 118.

From this it appears, that though the Magdeburg iron contains all the ingredients characteristic of meteoric iron, it is essentially distinct from all others hitherto examined, by the presence of molybdenum and arsenic; by the smaller and rather anomalous proportion of nickel and cobalt which enters into its composition; by the admixture of some capillary copper and of variegated copper ore, instead of the magnetic pyrites found in some meteoric iron; and, lastly, by the presence, though only a trace, of sulphuret of silver.

Professor Stromeyer then enters into an examination of the circumstances which appear opposed to the opinion which assigns a meteoric origin to this iron, and of the objections against its being the product of artificial fusion; among which, one of the greatest is its considerable alloy of molybdenum,—a metal which has hitherto not been observed either in ores of iron and copper, or in any slags or other products of smelting furnaces. But Dr. Stromeyer has since obtained, from the Hartz Mountains, a similar and equally problematical mass of iron, the analysis of which has furnished nearly the same results as that of the Magdeburg iron, except that it contained no variegated copper ore. Future observations will probably throw more light upon the nature of these enigmatical metallic bodies; at all events, the discovery of molybdenum in them is so far of great interest, as, in case they should ultimately prove to be artificial products, it is fair to conjecture that that scarce metal must enter into combinations still unknown to the chemical mineralogist, or occur in some ores in a masked state, and such small proportions as to

* The information extant on this subject would appear to be more precise than is here indicated; for Chladni has recorded the actual fall of meteorites at Magdeburg, in the above year. See Philosophical Magazine, vol. lxvii. p. 5.

become (like titanium) apparent only in the products of the long-continued operations of the smelting furnace.*

ON THE COMBINATIONS OF CARBONIC ACID AND AMMONIA.

By John Davy, M.D., F.R.S.

The author was led to the investigations of which he gives an account in the present paper, by finding in the note-books of his brother, the late Sir H. Davy, some memoranda of experiments which he had made on the salts of ammonia; and more especially on the carbonates. The first part of the paper relates to the direct combination of carbonic acid and ammonia, by which a salt is formed possessing singularly alkaline properties. The second is on the sesquicarbonate of ammonia ; a term which Mr. Richard Phillips has applied to that salt of ammonia which is commonly called the subcarbonate, and which is obtained by the mutual decomposition of carbonate of lime and sal ammoniac, by means of heat. This the author concludes, from his experiments, to be composed of one proportion ammonia, one and a half of carbonic acid, and one of water. He then enters into a comparative review of the analyses of this salt by other chemists, and gives an account of the results of his experiments to determine its solubility at different temperatures. He next proceeds to consider the bicarbonate of ammonia, which he finds to consist of one proportion of ammonia, two of carbonic acid, and two of water. He concludes by an inquiry into the effects of heat on the solid sesquicarbonate and the carbonate of ammonia, in which he reviews the experiments and inferences which Sir H. Davy has recorded in his manuscript notes.†

INFLUENCE OF COLOUR ON HEAT AND ODOURS.

By James Stark, M.D., of Edinburgh.

The author observes, that the only experiments on record relating to the modifying effect of different colours on the absorption of heat from solar light, are those of Franklin and of Sir H. Davy. In order to investigate this subject, the author employed pieces of wool, silk, and cotton, which were wrapped round the bulb of a thermometer placed in a glass tube: the tube was then plunged into boiling water, and the time which elapsed during the rise of the thermometer from one given point to another was accurately noted. Other experiments were also made with an air-thermometer, of which the bulb was coated with various coloured materials, and heat thrown on the ball by means of polished tin reflectors from an Argand burner. The results accord very nearly with those of Franklin and of Davy ; the absorbing power with regard to different colours being nearly uni-

* Philosophical Magazine. † Ibid.

formly in the order of *black, brown, green, red, yellow,* and *white.* The author next investigates the differences which occur in the radiation of heat by differently coloured substances; a subject on which he is not aware that any experiments have ever been made previously to his own. The mode of ascertaining the amount of radiation was generally the converse of that by which the absorption of heat had been determined; namely, by exposing the coloured substances, in contact with a thermometer, to cooling instead of heating processes. The general result of all his experiments was, that the loss of caloric by radiation follows exactly the same order, with regard to the colour of the radiating surface, as its absorption.

In the second part of his paper the author gives an account of a course of experiments which he made with a view to discover the influence of colour on the absorption of odorous effluvia, and more especially in the case of the absorption of the fumes of camphor and assafœtida by woollen cloth of different colours. Black cloth was always found to be possessed of the greatest absorbing powers, and white of the least; red cloth being intermediate between them. Cottons and silks gave, on trial, precisely the same results, which were further confirmed by the different weights acquired by these substances from the deposition of camphor upon them.

IMPREGNATIONS OF THE ATMOSPHERE NEAR THE SEA.

M. Roubaudi observes, that M. Vogel of Munich is the only chemist, as far as he knows, who has made any experiments on the atmosphere of the ocean. His experiments made on the Baltic prove,

1st, That the atmosphere of this sea contains less carbonic acid than that of the land, and that it is probable the carbonic acid diminishes proportionally to the distance from the continent.

2nd, That the atmosphere of the Baltic contains muriates in variable proportions.—*Journal de Pharmacie,* Septième année, p. 461.

M. Fodéré (*Voyage aux Alpes Maritimes,* tome ii. p. 256.) has observed, that the air of the Mediterranean disagrees with persons affected with pulmonary diseases, on account, as he supposes, of the presence of muriatic salts, or even muriatic acid, or one of its elements, developed by electro-chemical agency.

M. Roubaudi made several experiments in order to determine whether the atmosphere of the coasts contained either free or combined muriatic acid, and whether either of them existed in the atmosphere at some distance from the coast. In order to determine the first question, he suspended, some feet in the air and at a few paces distant from the sea, during calm weather, a

* Philosophical Magazine.

large glass baloon filled with a freezing mixture of snow and sulphuric acid. The atmospheric vapour which condensed on the outside of the baloon, produced a colourless inodorous liquid, which suffered no change by keeping six months. Neither the nitrate of silver, protonitrate of mercury, muriate of barytes, nor oxolate of ammonia, caused any change in it. It appeared to be perfectly similar to distilled water. Lime and barytes water were the only reagents with which this liquor became slightly cloudy, and after standing some hours they occasioned a slight deposit, soluble in nitric acid. The same apparatus, placed at the same distance from the sea when it was rough, condensed a liquor, which produced, with the following reagents, the annexed effects:

1. Nitrate of silver. An opalescent tint, which, on standing some hours, formed a light precipitate, possessing the characters of chloride of silver.

2. Protonitrate of mercury. White flocks which precipitated to the bottom of the vessel.

3. Barytes and lime water. Turbidness, and eventually a precipitate soluble in nitric acid.

4. Litmus paper. No change of tint.

5. Muriate and nitrate of barytes, ammonia, solution of potash, subacetate of lead, oxalic acid, and oxalate of ammonia, produced no appreciable effect.

During a calm season, but when the sea was rough, the fluid obtained by means of the same balloon, at the distance of about 50 feet, gave no precipitates with the fore-mentioned reagents; but when the wind blew from the sea towards the balloon, the liquid gave more or less of precipitates with them.

The same experiment was repeated on the sea, during a calm period. The baloon was suspended four feet from the surface, in a vessel at one hundred paces from the shore. The condensed liquor evaporated to one third of its bulk, produced no effect upon the above mentioned reagents.

M. Roubaudi then, with some variation in the mode of making the experiment, attempted to determine the extent to which the saline particles of the sea are carried from the shore; and from various experiments he concluded:

1st. That the air on the sea-shore, and over the sea, contains neither muriatic acid nor muriates.

2nd. That when the sea is rough, and especially when the wind is violent, particles of sea-water, in a state of great tenuity, float in the air, especially on the shore where the waves break; and that these particles are carried to greater or less distances according to the violence of the wind and the degree to which the sea is agitated.

3rd. That without attempting to determine the distance with great precision, it may be admitted, that at Nice, where the south

wind is seldom violent, the saline particles are rarely carried more than 100 paces inland.*

HYDROGRAPHIC PAPER.

M. Chevallier has examined a paper lately introduced, which may be written on with a pen dipt in water. He found that it was prepared by soaking the sheets of paper in a solution of sulphate of iron, drying, and then covering them with finely powdered galls. M. Chevallier states that similar papers may be prepared by using other solutions and powders;—thus blue is probably prepared by powdering the paper soaked in sulphate of iron with ferrocyanate of potash.†

IMPROVED PROCESS FOR THE EVOLUTION OF BORON.

By Professor Hare.

(*See the Engraving.*)

By means of an apparatus represented by the annexed engraving, I have succeeded in evolving boron by the reaction of potassium with vitrified boracic acid, in vacuo, without encountering the evil of any explosive action, to which the process, as heretofore conducted in pleno, has been found liable.

A circular brass plate, is prepared, like the plate of an air pump, so as to produce with any suitable receivers properly ground, an air-tight juncture. It is supported on the upper end of a hollow brass cylinder, B, with the bore of which it has a corresponding aperture. The brass cylinder is about three inches in diameter, and six inches in height, being inserted at its lower end into a block of wood as a basis. This cylinder receives below, a screw, which supports a copper tube, C, of about two inches in diameter, so as to have its axis concentric with that of the cylinder, and to extend about four inches above the plate. The copper tube, thus supported, is closed at the upper termination by a cup of copper, of a shape nearly hemispherical, and soldered at the upper edge, to the edge of the tube; so that the whole of the cavity of the cup, is within that of the tube. Hence the bottom of the cup is accessible to any body, not larger than the bore of the tube, without any communication arising between the cavity of the tube, and that of any receiver placed upon the plate, over the cup and tube, as in the figure.

Into the side of the cylinder supporting the plate, a valve cock is screwed, by means of which, and a flexible leaden tube, a communication with an air-pump is opened, or discontinued, at pleasure.

The cup being first covered with a portion of the vitrified boracic acid, as anhydrous as possible, and finely pulverized, the potassium is introduced, and afterwards covered with a further portion of the same acid, two parts of the potassium being used for one of the acid. A large glass receiver is now to be placed on the plate, secured by rods A, A, concentric with the tube and cup; from the heat of which the glass is to be pro-

* Journal de Pharmacie. † Journal de Chimie Medicale.

tected by a bright cylinder of sheet brass, s, placed around it so as concentrical with the receiver and tube.

The apparatus being so prepared, and the receiver exhau of air by means of the air pump, an incandescent iron is in duced through the bore of the tube, so as to touch the botto the copper cup. In a short time a reaction commences, w aiding the influence of the hot iron, renders the cup and contents red hot. A deep red flame appears throughout mass, after which the reaction lessens, and the heat declines.

When the cup has become cold, the air is admitted into receiver, and the contents are washed with water. If any of acid has escaped decomposition, it may be removed by boi the mass with a solution of potash or soda. After this treatm and due desiccation a powder will remain, having the charac istic colour and properties of boron.

The additional valve cock, represented in the figure, gives option of introducing dry hydrogen for the purpose of wash out atmospheric air, as described in the process for silicon.*

VALVE COCK.

By Professor Hare.

(*See the Engraving.*)

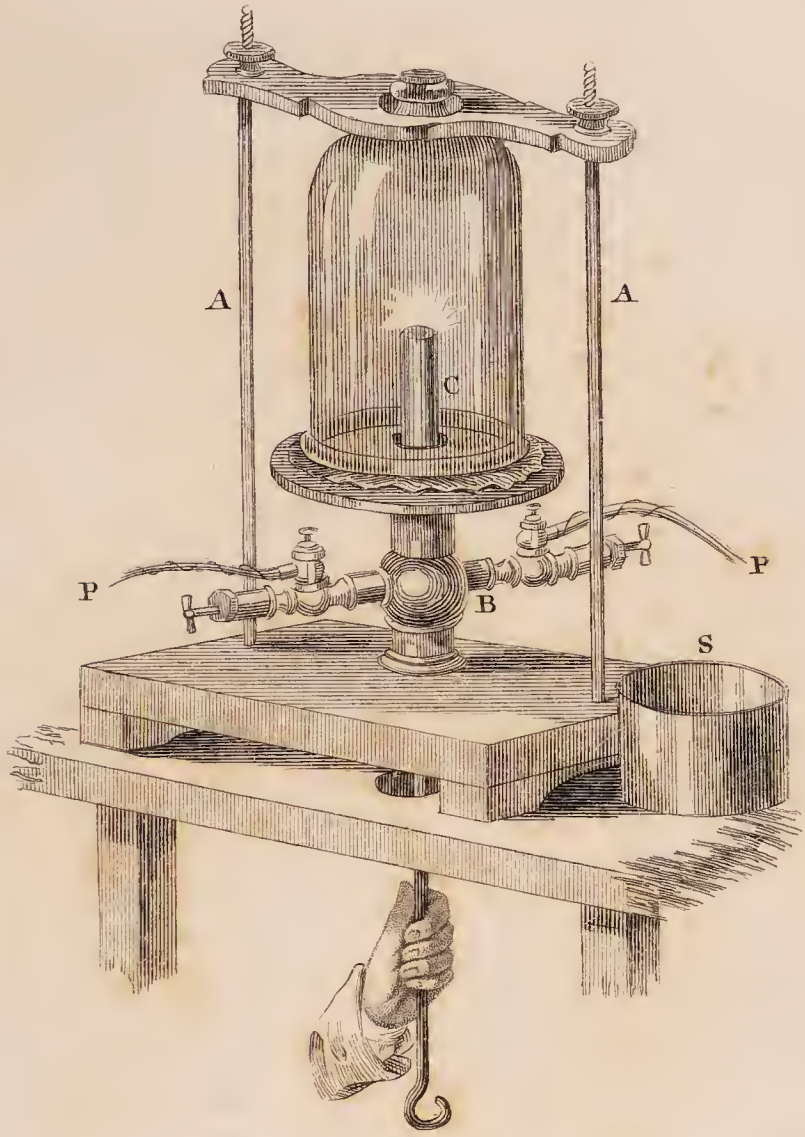
The following is the description of the Valv Cock, a perfe air-tight substitute for the common Cock, alluded to in the p ceding article.

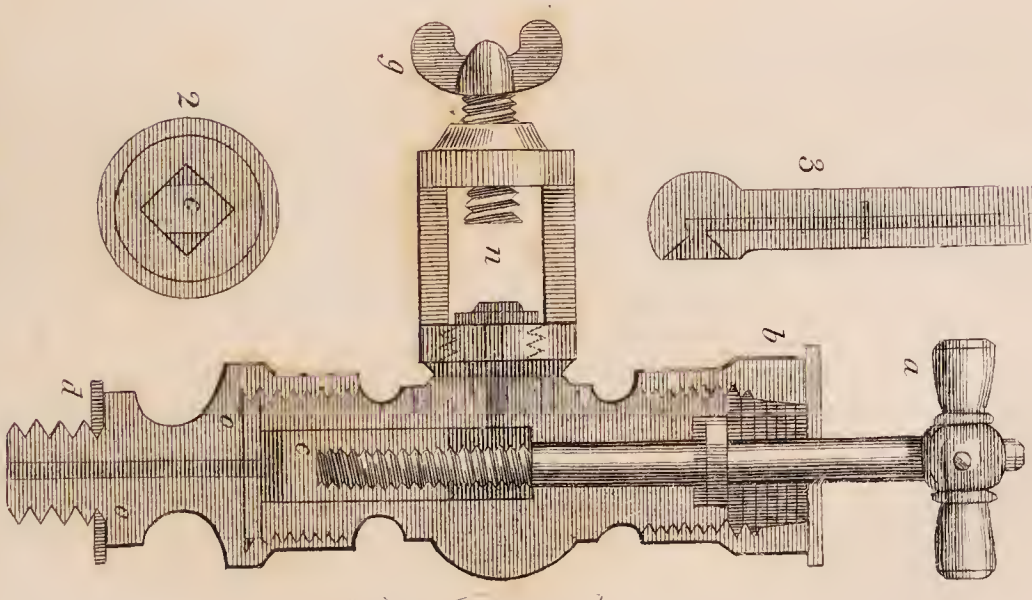
This figure is intended to illustrate the construction of a s stitute for a common cock, which I have been accustomed to a valve cock. It was devised by me about twenty years a among a number of other analogous contrivances, and see upon the whole less liable to fail than any other which I h tried.

The engraving represents a longitudinal section of the valve-cock. *a* is a piston with a collar inclosed in the stuffing box *b*, so as to be r dered air-tight by means of oiled leather. Hence the piston may turned or made to revolve on its axis, while incapable of other moti Upon the end of the piston a thread for a screw is cut which fits int female screw in the brass prism *c*, so as to cause this prism to appro to, or retreat from a bearing, covered by leather, in the centre of wh there is a perforation *o o* communicating with one of the orifices of instrument. This orifice is surrounded by the male screw *d*, so that means of this screw, the valve-cock may be fastened into an appropri aperture, properly fitted to receive it, subjecting an interposed leather such pressure, as to create with it an air-tight juncture. The prism has two of its four edges cut off (see fig. 2,) so as to allow a free pass by it, reaching to the lateral perforation terminating in another orifi over which there is a gallows screw, *g*. By means of this gallows scre when requisite, a brass knob, such as that represented by a fig. 3, s dered to a leaden pipe, may be fastened to the valve-cock. The junctu

* Silliman's Journal.

Evolution of Boron.





Valve Cock.

London J. Limbird 143, Strand

rendered air-tight by the pressure of the screw in the gallows, upon a ther which is kept in its place, by means of the nipple *n*.

The method last mentioned, of producing an air-tight juncture, as contrived by me about seven years ago, and proves to be of ry great utility. There is no other mode with which I am acainted, of making a perfectly air tight communication, between e cavities previously separate, at all comparable to this in cility.*

PREPARATION OF PURE NITRATE OF SILVER.

By M. Bradenburgh.

DISSOLVE in nitric acid the common alloy of silver and copper. Evaporate to dryness, and heat the salt in an iron spoon till it ceases to boil. Dissolve, then, a very small portion in water, and try it with ammonia to see if any copper remains. If there , heat it again a few seconds, and make a new trial: as soon as ne nitrate of copper is decomposed, pour it on an oiled plate, or ilute the mass in water, and filter it to separate the deutoxide of opper set free by the decomposition of the nitrate.

MEMOIR ON STARCH.

By M. Guibourt.

WE are indebted to M. Raspail for the interesting discovery hat starch is not a homogeneous substance,—that each granule s a real organ, consisting, 1st of a shining envelope or tegument, nattackable by water and acids at common temperatures, susceptible of being highly coloured by iodine; 2nd, of an interior substance, soluble in cold water, liquid, even in its natural state, and when evaporated loses the property of being coloured by iodine, and which possesses all the properties of gum. He further states, that the colouring of starch blue by iodine, is owing to a volatile substance, but my own experiments are contrary to this assertion.

Potato starch is quite insoluble in cold water. When rubbed in a dry state on a stone, it loses its white shining appearance, and if it be moistened with water it forms a tenacious paste which becomes very hard, when dry. Pounded in a mortar, it produces a mucillage analogous to gum tragacanth. Starch, in mass, acquires a sky blue colour with iodine, but slowly, without losing its transparency. When rubbed and diluted with cold water, it forms a solution which holds in suspension the teguments which served as a covering to the grains of fecula. Iodine colours the fluid a sky blue, and the integuments a deep blue, almost black. The portion soluble in cold water, subjected to a protracted ebullition, does not lose the property of being

* Silliman's Journal.

coloured by iodine. Evaporated rapidly, so as to form gelatinous pellicles and a gummy liquid, it is no longer entirely soluble in cold water; but neither the gelatinous matter nor the transparent liquid, loses the power of being strongly coloured by iodine.

Soluble starch, therefore, when dry is not a gum, as M. Raspail imagined.

On the whole, we cannot avoid the conclusion that the teguments and the soluble substance differ more in form than in their chemical qualities, and that they constitute an immediate principle of vegetable matter.

The *amidine* of De Saussure is nothing but the tegumentary part of starch rendered soluble by long boiling.*

ACTION OF POTASH ON ORGANIC MATTERS.

By Gay-Lussac.

A GREAT number of vegetable and animal substances, treated with caustic potash or soda, at a temperature much below redness, are transformed into oxalic acid, and at a higher heat, into carbonic acid. Such are saw dust, cotton, sugar, starch, gum, the tartaric, citric and malic acids, silk, uric acid, &c. Many vegetable substances yield hydrogen and carbonic acid at the same time, and animal substances, in addition to these two, give ammonia and cyanogen. It is remarkable and extraordinary, that with tartaric acid, scarcely any hydrogen is disengaged, and the material does not blacken.

Tartar may be transformed into oxalate of potash by a very elegant process, which consists in dissolving tartar in water, with a suitable quantity of potash or soda, and forcing the solution, by means of a pump, into a thick tube of iron or brass heated to about 400° F. The pressure would be but about twenty five atmospheres, as no gas is disengaged.†

USE OF MICA IN CHEMICAL ANALYSES ON A SMALL SCALE.

As mica is not fragile, and does not change in the flame of a taper, it may be employed with much advantage, as a support to substances which we wish to expose simply to the flame of a lamp or candle; take a thin plate of mica, which may be easily separated from the mass by a knife, and after each experiment, wipe it with a moist cloth.‡

INDELIBLE COLOURING.

IN impregnating, in an even manner, the surface of cloth with a solution of nitrate of silver, and after drying it, immersing the

* Journal de Chimie Medicale. † Annales de Chimie.
‡ Arch. de Brandes.

loth in a solution of hydroclorate, or of chloride of lime, chloride of silver is formed, which adheres strongly to the fibre, and if afterwards the cloth is exposed to the light, it immediately acquires a bluish grey tint, very clear and agreeable, which resists the action of chlorine, ammonia, &c. In order that it may be perfectly uniform, the whole piece must receive the action of the sun's rays at the same time.*

ARTIFICIAL ULTRAMARINE AT A MODERATE PRICE.

Since M. Tassaert made the curious observation of the blue colour of soda furnaces, and Vauquelin proved the identity of this colouring matter with that of lapis lazuli, the hope has been cherished that, sooner or later, ultramarine would be manufactured in sufficient abundance. The Society of Encouragement having offered a premium on this subject, M. Guimet presented a beautiful blue of an azure reflection, and the premium was adjudged to him. M. Robiquet, who had also engaged in this research, thought it right to publish the process which had succeeded best with him, and which, without giving so beautiful a blue as that of Guimet, will nevertheless furnish the colour at a lower price, and applicable to paper staining.

Take one part of kaolin, one and a half of sulphur, and one and a half of pure and dry sub-carbonate of soda; mix them carefully and introduce the whole into a coated earthen ware retort, and heat the mixture gradually until the vapor has entirely ceased. On cooling, it forms a spongy mass, which reflects, at first, a green tint, but on exposure to the air, it becomes more and more blue. Leach this mass: the excess of sulphur is dissolved, and there remains a powder of a good blue. It is to be washed by decantation, dried, and calcined to a cherry red, to drive off the excess of sulphur.

The greatest defect of the colour thus obtained is want of intensity. The purple shade, which the natural ultramarine does not possess, at least in so marked a degree, may well owe its distinctness to substances employed in refining it. It is certain that when the Guimet blue is heated, it loses in a great degree its azure tint, and if the experiment is made in a tube, oily streaks issue from it, which must necessarily proceed from organic substances.†

NEW FEBRIFUGE.

Among the vegetable bitters found in France, *Verdé-Delisle* and *Cottereau* have discovered that the leaves of the Ypréau or White Dutch Poplar hold the first rank. The fresh leaves of this tree are endowed with a bitterness which approaches to that of the

* M. Robiquet, Journ. de Pharmacie.

† Revue Encyclopedique.

Cinchonas. They have been ascertained to possess, in a high degree, both in infusion and in maceration, the property of counteracting the periodicity of fevers.*

ANALYSES OF CAMPHOR AND SOME VOLATILE OILS.

M. Dumas observes, that essential oils may be divided into—first, those which are entirely composed of carbon and hydrogen, such as the oil of lemon, turpentine, and naphtha; secondly, oxygenated oils, as camphor, oil of aniseed, and many others; thirdly; the essential oils which admit of a new element in their composition, as the oil of mustard, which contains sulphur, and that of almonds, which contains azote.

Some fine isolated crystals of camphor taken from the centre of a sublime cake of that substance, yielded each such proportions of carbonic acid and water as by M. Dumas' calculation gave per cent. very nearly

Carbon.....	79·28
Oxygen.....	10·36
Hydrogen.....	10·36
	100·

Neglecting on this, as on other occasions, the atomic weights adopted by M. Dumas, it will be seen that camphor is composed of

Ten atoms carbon	6×10=60 or	79
One atom oxygen	8 or	10·5
Eight atoms hydrogen	1×8 = 8 or	10·5
	76	100·

Proust discovered the existence of camphor in oil of lavender; M. Dumas analyzed some crystals of lavender camphor procured from the College de France: the results were perfectly similar to those obtained from common camphor.

M. Dumas considers camphor as composed of a peculiar carburretted hydrogen (to which he gives the name of *camphogen*), and oxygen, or ten atoms carbon +eight atoms hydrogen; or

Camphogen.....	68	89·4
One atom oxygen.....	8	10·6
	76	100·

The density of the vapour of camphor was found to be 5·468, and M. Dumas observes that supposing it be composed of a volume of camphogen=4·7634+half a volume of oxygen=0·5513, its density would be 5·3147, which comes very near to the experimental result. Oil of turpentine was found to be constituted precisely of the same proportions of carbon and hydrogen as camphogen:—the density of its vapour was by experiment 4·765 to 4·764, which agrees with the analysis.

When oil of peppermint is cooled to about 32°, it yields pris-

* Silliman's Journal.

matic crystals, readily separable from the fluid part. These crystals pressed between folds of blotting paper, are colourless; fusible at 75° Fahr., volatile without decomposition, and again crystallize; they are very slightly soluble in water, but dissolve in alcohol, ether, and oils. They have the smell and taste of peppermint in a great degree. By analysis it appeared that this camphor was composed of 77·3 carbon, 12·6 hydrogen, and 10·1 oxygen in 100 parts; and it differs from common camphor in containing two more volumes of hydrogen.

The solid portion of oil of aniseed yielded by analysis, in 100 parts, 81·35 carbon, 8·26 hydrogen, 10·39 carbon: by adjusting these results, slightly, it appears that oil of aniseed contains two volumes less of hydrogen than common camphor.

M. Dumas conceives that essential oils are compounds of hydrogen and carbon, which, by oxidizement, produce camphors; this degree of oxidizement, however, is not to be confounded with the higher degree of it which occurs when the oils are freely exposed in thin strata to the air, for they are then converted into resins.

It appears from these experiments, that

10	carbon	10	hydrogen	1 concrete oil of peppermint.
10	——	8	——	1 oxygen form common camphor.
10	——	8	——	oil of turpentine.
10	——	6	——	1 concrete oil of aniseed.
10	——	4	——	naphthaline.

M. Dumas is disposed to believe that the absorption of oxygen by essential oils, produces different effects according as it occurs under the influence of water or when dry. The constitution of pure oil of lemons appears to be perfectly similar to that of oil of turpentine by M. Dumas's analysis, and it differs very little from that of M. Th. de Saussure. M. Dumas finds naphtha to be composed of 6 atoms carbon+5 hydrogen; a conclusion which also agrees nearly with that of M. de Saussure; the density of its vapour should therefore be 2·870, which varies but slightly from that obtained by experiment.*

SUBSTANCES CONTAINED IN OPIUM.

M. Pelletier in an elaborate memoir on opium, printed in the *Annales de Chimie*, mentions the following principles as contained in opium; viz. narcotine, morphia, meconic acid, meconine, narceine, caoutchouc, gum, bassorine, lignin, resin, brown acid and extractive matter, fixed oil, and a volatile but non-oleaginous principle, which rises in distillation with water.

Added to these substances M. Bebert announces (*Journal de Pharmacie*, April 1832,) another peculiar principle; it is bitter, crystallizable, forms salts with acids, especially with acetic acid,

* Annales de Chimie.

with which it gives crystals in the form of very white scales, and with sulphuric acid, white silky crystals;—no name is given to this substance by its discoverer.

M. Robiquet, it also appears, has separated a new alkali from opium, which he calls *paverin*. Only a few details of its properties are as yet given (*Journal de Pharmacie*, Nov. 1832.) It differs very remarkably from other vegeto-alkalies in being soluble in water. It saturates acids, is insoluble in potash, and contains much azote; it is very poisonous, and acts very particularly on the spinal marrow.*

METHOD OF OBTAINING HOMOGENEOUS LIGHT OF GREAT INTENSITY.

It is only requisite to place a lump of common salt upon the wick of a spirit-lamp, and *to direct a stream of oxygen gas*, from a blow-pipe, upon the salt. The light emitted is quite homogeneous, and of dazzling brightness. If instead of common salt we use the various salts of strontian, barytes, &c. we obtain the well-known coloured flames, which are characteristic of those substances, with far more brilliancy than by any other method with which I am acquainted.†

POLISHING POWDER.

Certain of the French manufacturers of polishing powder use in their manufacture scraps of old iron, which they put into a tub and cause to rust quickly by sprinkling with water.

When a sufficient quantity of rust has thus been formed, it is collected by washing, and after allowing it to settle, it is dried and calcined in a crucible.

The longer the calcination is continued, the more the oxide approaches to a violet hue, and the harder its grain. At a very high temperature the oxide is partly reduced, its colour becomes more grey, and the grain is too hard for polishing.

The red oxide serves for polishing gold and silver, the violet oxide is fit for polishing steel.

When taken out of the crucible, it is first triturated, and then levigated, in order to collect the finest parts.‡

OXYGENATED WATER.

M. Thenard announces, that having been consulted by physicians, relative to the mode of preparing in an easy manner, the oxygenated water which is supposed to be useful in the symptoms of cholera asphyxia, he has modified the common process

* Philosophical Magazine.

† H. F. Talbot, Esq., M.P. F.R.S. in the Philosophical Magazine.

‡ Repertory of Arts.

so as to render it very simple. It is only necessary to add to the hydrochloric acid used in dissolving the peroxide of barium, a small quantity of phosphoric acid. This acid seizes the oxide of manganese, and other metallic oxides which may exist in the solution, and hinders them from decomposing the binoxide of hydrogen.

When the liquor is saturated and prepared in the ordinary way, it is sufficient to add a convenient quantity of sulphate of silver, or even an excess of sulphate of protoxide of mercury, to agitate a while and filter.*

CRUCIBLE FOR FUSION.

Persons who wish to melt or assay steel are not aware how easy it is to obtain, in the space of twenty minutes, a melted mass of one or two ounces without the least difficulty, by means of the following arrangement.

Make a hole in the bottom of a Hessian crucible holding two or three quarts,—put inside of this crucible the cover of a smaller crucible so that it may rest at about three-fourths of the depth. Make with a file several notches around this cover to admit the air freely, having the knob of the cover uppermost. On this knob place a little crucible containing the metal, which must be covered,—put some lighted charcoal around it, and then fill up with coke (or anthracite coal?) so as to cover entirely the interior crucible. Connect this apparatus with a blacksmith's or other bellows, and keep a constant blast, supplying the waste coal as it is consumed,—in the course of the time mentioned, the steel will be melted. Other minerals, even some that are reputed infusible, will yield in like manner. The simple and cheap apparatus abridges time and labour surprisingly, and effects what with the common and costly furnaces would be impossible.†

ELECTRO-MAGNETIC MACHINE.

An apparatus giving a continued series of electric sparks by means of a movable needle has been recently constructed by the sons of M. Pixii. This apparatus consists of two horse-shoes of equal divergence, the one magnetized steel, the other soft iron. They are placed end to end in a vertical plane, which passes through their common axis; the opposed extremities, though very near, do not touch. The transverse sections are for the magnet a rectangle, and for the soft iron a circle, whose diameter might equal the width of the rectangle. A copper wire surrounded with silk makes several revolutions on the two branches of the soft iron; it is retained there by four circular plates of

* Revue Encyclopedique.

† Ibid. quoting Le Journ. de Connaissances Usuelles.

copper, of which two level the circular extremities of these branches. The extremities of the copper wire are directed towards a capsule, or glass bottle, containing mercury, and kept in a state of rest at a small distance from the surface of this metal. The horse-shoe magnet, whose curve is downwards, turns on its axis, which is vertical, and at each semi-revolution its two polar extremities, north and *south*, are in conjunction with the soft iron which are fixed, and on which the magnet acts by influence at the small distance which separates them. The same magnetary influence is communicated to the covered wire, and produces at the extremities of this wire a series of electric sparks perceivable on the surface of the mercury. If one of the ends of the copper wire surrounding the soft iron is immersed in the mercury, the spark will be brighter at the extremity not immersed, and two successive sparks will be owing to contrary electricities, as has been already shown in the excellent paper of Dr. Faraday.

The soft iron and copper wire surrounded with silk which encompasses it being in a fixed position, the magnet is made to turn by means of a handle and wheel which catch a horizontal pinion mounted on the axis of rotation of the magnetized horse-shoe, which axis is beneath the curve of this latter. This new construction is founded on the well known fact that a magnet acts at a distance on soft iron, which becomes itself magnetized, and preserves its magnetism as long as this soft iron is within the sphere of the magnet's action.

The magnet in the apparatus constructed by M. Pixii, weighs 2 kilogrammes and may raise 15. Its transverse section is a rectangle, whose sides are 35 and 10 millimetres. The vertical height of the horse-shoe in the direction of the axis is 21 centimeters: the divergence of the polar extremities, 2 centimeters. This divergence is the same between the opposite ends of the soft iron, whose cylindrical branches are 15 millimetres in diameter. The heights of these branches is about 8 centimeters. The length of the wire is 50 metres, its weight a quarter of a kilogramme.

The glass bottle containing the mercury is placed in the wooden frame of the apparatus, and participates in the vibratory motion which arises from the shock of the teeth of the pinion fixed on the axis of the magnet by the wheel which catch this pinion.

This motion raises the surface of the mercury to the height of the extremity of the wire not immersed. The motion of the mercury taking another direction, the spark appears just where the extremity of the wire emerges from it.*

* Annales de Chimie.

FERRO-PRECIPITATE OF QUINA.

Mr. Bertazzi, an eminent chemist of Cremona, has given the following process for obtaining the ferro-prussiate of quina: take one part of sulphate of quina, which is to be triturated in a glass mortar, so as to reduce it to a very fine powder: then add this to one part and a half of ferro-prussiate of potash dissolved in six or seven parts of boiled water: after having mixed these substances anew, expose to the fire in a phial this compound, shaking it from time to time, till the liquid boils. The solution throws down to the bottom of the vessel a substance of a greenish yellow, having an oily consistence. After decanting the liquid, this substance is to be washed in distilled water, for the purpose of separating it from the undecomposed sulphate of quina, as well as from the hydrocyanate and sulphate of potassa, which might also be combined with it: the washing being concluded, and the water thrown away, this substance is to be dissolved in very fine alcohol, which is to be exposed to a temperature of 30° Reaumur, to effect its solution: then filter, and by evaporation there is obtained a substance confusedly crystallized in needles, the weight of which corresponds to the three-fourths of the sulphate of quina employed. This substance when dried is of a greenish yellow colour, and of a very bitter taste, first giving the sensation of quina and then of hydrocyanic acid. The decomposition of the ferro-prussiate of quina is partial in cold water, and nearly complete in hot water: it then forms two salts, the one soluble, and the other insoluble. The alcohol dissolves it in the cold, but dissolves it still better when boiling.*

ON THE CHEMICAL AGENCY OF WATER.

By M. Pelouze.

Anhydrous alcohol, sulphuric ether and acetic ether, disguise, more or less completely, the properties of the strongest acids. Their solution does not redden litmus, nor decompose a great number of carbonates. A mixture of about 6 parts of absolute alcohol and 1 part of concentrated sulphuric acid does not act upon any neutral carbonate, but it immediately decomposes acetate of potash, and disengages abundant vapours of vinegar mixed with acetic ether.

It is well known, since the labours of Hennell and Serullas, that sulphovinic acid is formed in the cold, in a mixture of alcohol and concentrated sulphuric acid, but whatever may be the excess of alcohol employed, free sulphuric acid remains in the mixture. It is therefore reasonable to conclude, from the above-mentioned experiment, that an alcoholic solution of sulphovinic

* Revue Medicale, from the Annali Universali de Medicina.

and sulphuric acid is incapable of decomposing a carbonate; water must be added that the action may occur.

A solution of muriatic acid gas in alcohol, so concentrated that when diluted with several hundred times its volume of water it reddens litmus-paper, attacks artificial carbonate of lime and even marble itself with extreme violence. It also attacks, but less strongly, the carbonates of barytes, strontia, magnesia, and soda, even when they have been previously calcined; but on the contrary, it does not decompose carbonate of potash. Concentrated nitric acid mixed with alcohol does not decompose carbonate of potash; it acts energetically upon the carbonates of lime and strontia; those of barytes, magnesia, and soda are also attacked, but much more slowly.

Vegetable acids produce similar effects; the tartaric, paratartaric, citric, and oxalic acids all dissolve in notable quantity in alcohol; the solution of the two first did not act upon any of the numerous carbonates with which it was put in contact. The alcoholic solution of citric acid does not act upon the carbonates of strontia, lime, or barytes, but it attacks the carbonates of potash and magnesia, though the latter with extreme slowness.

Oxalic acid, which disengages carbonic acid from the carbonates of strontia, magnesia, and barytes, does not act at all upon carbonate of potash or of lime. These facts show, that on many occasions in which alcohol is employed in chemical investigations, it will prevent the operator from discovering the presence of an excess of acid by litmus paper.

M. Pelouze remarks that some of the facts cited may be satisfactorily explained, while others are quite inexplicable. What is the reason, for example, why concentrated acetic acid does not act upon carbonate of lime, while it combines so energetically with caustic lime? Why is water required in the first case and useless in the second?—for in both cases the same product is obtained. Thus acetic acid dissolved in alcohol, and acetic acid dissolved in water, may be considered, with relation to certain bodies, chalk for example, as acids entirely distinct from each other. Acetic acid dissolved in alcohol is to the carbonates, what carbonic acid is to the acetates dissolved in alcohol; that is to say, in one case there is no action, and in the other it is strong.

Chloride of strontium, chloride of copper, and nitrate of copper, when dissolved in alcohol, were not decomposed by exposure to a long-continued current of carbonic acid gas.

The presence of water does not appear to be always necessary to chemical action; in many cases it may occur with other solvents. Oxalic acid dried under the receiver of the air-pump and dissolved in absolute alcohol, precipitates a similar solution of nitrate flame. Sulphocyanate of potash gives as deep a colour to permuriate of iron dissolved in alcohol as in water.*

* Annales de Chimie.

METHOD OF CLEANSING WOOL FROM ITS GREASE, AND ECONOMIZING THE RESIDUE.

M. DARCET, who has long been consulted by manufacturers, advises the following method, which has been tried with complete success. Immerse the wool, well washed from dirt, in a vessel containing spirits of turpentine, and let it remain from thirty six to forty-eight hours. Withdraw and immerse a fresh quantity. By means of a press, force out all the adhering spirit, spread the wool out to dry, and when it is to be used, wash it in warm water containing a little alkali.

When the spirits of turpentine will no longer act upon or remove the grease, distil it for fresh use, and the matter remaining in the still, treated with soda, will make good soap.*

COMPOSITION OF THE "SILVER" BELL AT ROUEN.

M. GIRARDIN professor of chemistry, has by a careful analysis, ascertained that the celebrated bell at Rouen does not contain any silver. One hundred parts by weight contain—

Copper	71
Brass	26
Zinc	1·80
Iron	1·20
	100

Modern French bells differ little from the above, being composed of—

Copper	78
Brass	22
	100

Thus, the prejudice which has long existed, that the old church-bells contained a smaller or larger portion of silver, is destroyed by the efforts of science.†

ON AN HITHERTO UNOBSERVED PROPERTY OF CHLORINE.

By A. Trevelyan, Esq.

CHLORINE gas has been observed to possess the same property as oxygen in kindling the flame of a candle when introduced into it with the wick in an incandescent state. Mr. Trevelyan ascertained this by introducing into a jar of it, a candle, the flame of which had been previously extinguished by withdrawing it from that gas; it was immediately rekindled, and the experiment was repeated several times in the same measure of gas.‡

* Silliman's Journal. † Repertory of Arts.
‡ Philosophical Magazine.

CARBONATE OF POTASH FROM GREEN AND DRY PLANTS.

M. Becquerel has made some experiments on the manufacture of potash. The comparative analyses of a great number of ashes have proved that those of green wood yield a much greater proportion of saline matter, than those of dry wood. This difference is especially striking with the ashes of fern; the ley of the ashes contains a mixture of subcarbonate and sulphate of potash; the proportion of the former varies from 0·45 to 0·65; it is this variation which causes the great difference of quality and price in potash of commerce; it becomes, therefore, very important, in the manufacture of potash, to separate the sulphate with which the subcarbonate is mixed. M. Becquerel effected this by concentrating the solution to spec. grav. about 1·4, and allowing it to cool: the greater part of the sulphate of potash crystallizes on cooling, and the saline matter which remains in solution contains afterwards 0·90 of subcarbonate. M. Becquerel has also ascertained, by his numerous analyses of different kinds of ashes, that those of the lime-burner contain very little sulphate of potash, which is undoubtedly due to the action of the lime upon the sulphate of potash, with the assistance of charcoal. This fact, M. Becquerel remarks, may lead to some advantage, by adding lime to the wood, the ashes of which are intended for the manufacture of potash.*

ACCOUNT OF AN APPARATUS FOR MAINTAINING AN UNIFORM TEMPERATURE.

By George Merryweather, Esq.†

Mr. Merryweather has invented an apparatus which he hopes will be the means of solving an important problem, that has long remained an insurmountable obstacle in the path of science.

When the French chemists promulgated their nomenclature to the world, Fourcroy published the following:—

"Heat is now regarded only as an auxiliary agent, by which combinations are forwarded. As it is employed in different degrees, it would be a valuable acquisition if we knew how to apply it with uniform intensity. A furnace of this kind has long been a desideratum among chemists, and the manipulations of artists have hitherto been the only guide to the chemist, but it is impossible by this means to have the degree of precision so much to be desired."

It is nearly half a century since Fourcroy wrote the above, since which time the most gigantic progress has been made in science; yet this important point appears to have been lost sight

* Journal de Pharmacie.

† Read before the Royal Society of Edinburgh.

of, or has been considered, like perpetual motion, an object never to be attained. Indeed, when we reflect that fires and furnaces are constantly consuming, and must be constantly renovated with fuel, and when we consider that flame must ever be in agitation, from the very atmosphere from which it derives its existence, it is not astonishing that all attempts should have proved futile, to arrive at a steady temperature, for a length of time, by these means.

In a philosophical point of view, Mr. Merryweather trusts this apparatus will be considered interesting, as proving the fact, that a uniform temperature *can* be steadily maintained in despite of external influences; and that it can be kept in constant operation, for an indefinite period, without requiring any one to attend to it.

It remains for scientific men to prove what its utility may be in chemistry and in pharmacy; and whether phenomena, at present unknown, may not be produced by submitting different substances, for a length of time, to the uniform temperature, that this apparatus will maintain. Boerhaave first produced the red oxide, by keeping mercury at the steadiest temperature he could procure for many weeks.

Mr. Merryweather rather anticipates an objection that may be made to this furnace, *i. e.* the expense of the spirit consumed: but every one who has observed the constant attendance and watchings, which every process requires where fire is employed, will easily perceive, that what is expended in spirit will be more than economized in time. It will, he hopes, be sufficiently obvious, that, in conducting experiments by this apparatus, there will be no fires to mend,—no chimneys to sweep, (as it causes no smoke); and, from the precision of temperature, there will be no danger of explosions or boilings over. For instance, a practitioner may commence his process of distillation in the morning, —he may attend to the calls of his profession, and be satisfied during his absence that all is going on steadily. But, as the expense of all processes is an important consideration, the inventor has been induced to make the following calculation. He finds that one gallon of spirit, twenty-two over-proof, which costs 9*s*. from the distiller, will keep one of the balls incandescent for two months, night and day; or a fraction less than a penny for twelve hours. Three burners cause a temperature of 160° of Fahrenheit;—six produce a temperature of 215°; therefore, the expense of supporting the former for twelve hours will be 3*d*. and the latter 6*d*. The apparatus has fifteen burners elevating the temperature to nearly 396°, making the expense 1*s*. 3*d*. for the same period.

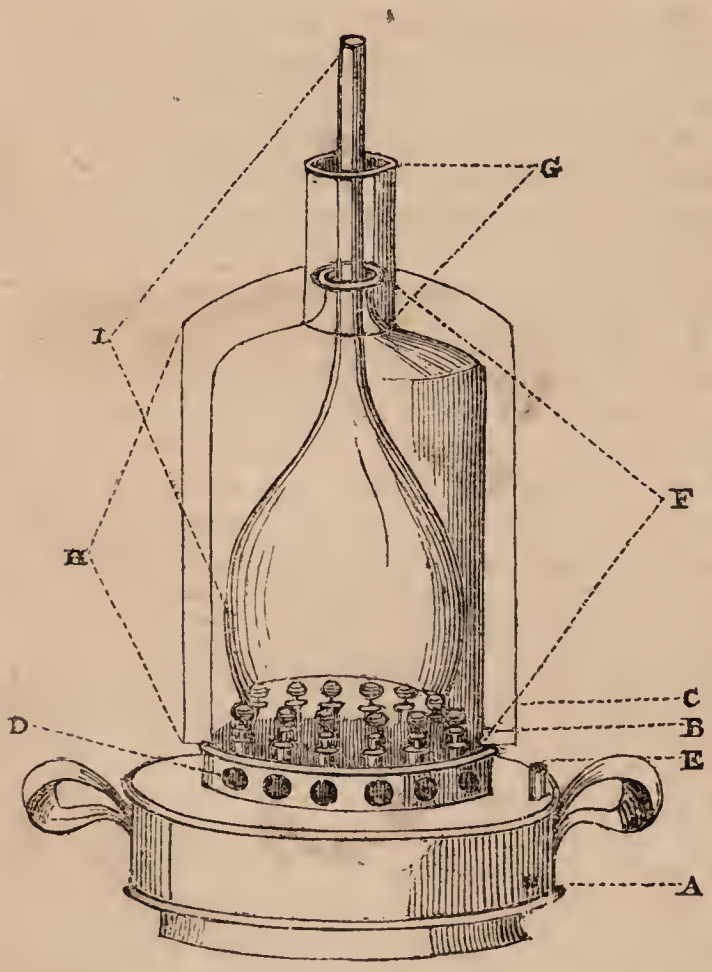
Mr. M. is indebted to Dr. Duncan, the Professor of Materia Medica, for suggesting the amount of temperature which he produced before the Royal Society. And he has no doubt, if it had been necessary, he could have produced a temperature of 1000°;

but he is informed, that a heat of 300° to 350° is the most desirable temperature.

Mr. Merryweather leaves an account of the process of combustion, with deference to the more refined chemist; and he will only venture the conjecture, that it will be found, that the intense heat, produced by apparently such small bodies, is from the combustion of oxygen and hydrogen by the means of spongy platina, and that water will be found to be the product, mingled with a portion of acetic acid, and derived from the spirit.

Mr. Merryweather did not present this furnace to the Royal Society as a perfect apparatus, because he was aware that it admitted of various improvements and modifications.

Explanation of the Cut.



A. A reservoir made of tin, nine inches in diameter, concave at the bottom interiorly, and deep enough to hold one gallon of spirit. The hole at the side and lower part is to connect, by means of a tube, the reservoir, with one containing a larger supply of spirit. This extra supply will be necessary, when an experiment is to be conducted for a length of time.

B. Are the cotton wicks, which perforate fifteen brass tubes, each of which is similar to the brass work accompanying a common spirit lamp. When the wick is drawn through, it is to be spread and flattened. Each wick is to be sufficiently long to touch the bottom of the reservoir. The fifteen brass tubes are to be inserted into fifteen tin tubes, three quarters of an inch in diameter, which are soldered to the top of the reservoir; namely, twelve in a circle, and three in the centre, the latter to be shorter and lower than the former, in order that a globular retort may approximate equally to each wick.

C. Is the platina wire about the hundredth part of an inch in diameter, coiled into the form of a cup, the upper part of which is one-third of an inch in diameter; this cup is supported by a pin, formed by a continuation of the wire. A large headed common pin is pricked into the centre of the wick, to make an opening for the insertion of the pin of the wire-cup. The head of the large pin is then placed in the bottom of the cup

to depress it, nearly in contact, but not to touch the wick. When all the coils of wire have been thus arranged, a piece of well compressed spongy platina is to be cut into small blocks, of sufficient size, to rest in each wire cup.

D. Is a tin rim soldered to the top of the reservoir, perforated with twelve holes, each three quarters of an inch in diameter, for the admission of air.

E. A tin tube for supplying the reservoir with spirit.

F. Is a glass cover with a wide neck, (this glass is precisely similar to the common deflagrating jars,) it rests upon a tin ledge, soldered inside round the rim D, above the air-holes.

G. Is a tin tube or chimney, which rests upon the shoulders of the glass cover F.

H. Is a screen made of tin, which is large enough to surround the glass cover, and to leave a space an inch distant all round it. This screen is supported by a projecting rim of tin at the bottom, on the same ledge that the glass cover F rests upon. It is advisable to have the interior surface of this screen lined with some material that is a bad conductor of heat.

I. Is a glass flask or retort, rounded at the bottom, which is placed upon a brass ring, supported by three legs. It is necessary to have all retorts that are used, perfectly rounded at the lower part, in order that, when the apparatus is adjusted, the retort will be at an equal distance, not to touch, but to be nearly in contact with, each of the platina balls.

Belonging to the furnace is a tin cover, which is used when the apparatus is at rest. The screen and glass cover are withdrawn, and a tin cover is placed over all the burners, and rests upon the top of the reservoir, covering the rim perforated with air-holes. This tin serves as an extinguisher, it prevents the spontaneous evaporation of the spirit, it protects the platina balls from injury, and preserves all clean. The whole of the tin-work is japanned externally.

When an experiment is about to be performed, the tube G is taken off, then the screen H, afterwards the glass cover F. The wicks are then to be saturated, by dropping stronger alcohol upon each of them, after which they are to be lighted; in a few seconds the platina balls become red hot, the flame is then blown out, the retort with its contents is fixed on the brass stand, which is placed within the circle of the twelve burners. Then the glass cover, screen, and tube, are replaced as before.

The best and neatest mode of setting the apparatus into operation, is to render each of the platina balls incandescent, by means of the blowpipe and spirit lamp; as soon as the balls are red hot, the vapour of the spirit is excited, and renders the dropping of stronger alcohol quite unnecessary. For this suggestion Mr. Merryweather is indebted to Professor Christison.

When it is wished to have any lower degree of temperature, the experimenter has only to withdraw some of the brass tubes, in doing which he takes away at the same time the wicks and platina balls; corks must then be placed in the tin tubes, to prevent the unnecessary evaporation of the spirit.*

* Jameson's Journal.

MIRRORS OF FUSIBLE ALLOY.

Berzelius has found that by the union of nineteen parts of lead and twenty-nine of tin, a fusible alloy is produced, which affords, on cooling in thin plates, very bright surfaces. A convex lens dipped several times into the melted alloy, yielded from the surface dipped, a concave mirror of great lustre. This, mounted upon plaster, was preserved for some time in the air untarnished. Dust destroys these mirrors, which will not bear wiping.*

STATE OF MERCURY IN CITRINE OINTMENT.

M. Cedie, after passing in review the works hitherto published on the subject of which he treats, establishes it as a fact, that the mercury is in a state of protonitrate in recently prepared citrine ointment, whilst ointment prepared for a long time contains merely metallic mercury minutely divided, which imparts to it the greyish colour.

He has verified these facts by treating this ointment with sulphuric ether. In the first case he separated from it a white powder, possessing the properties of protonitrate of mercury, and in the second a grey powder, which is nothing but minutely divided mercury. M. Cedie admits that the deuto-nitrate of mercury employed in the preparation of citrine ointment is first brought to the state of protonitrate by the deoxidizing power of the fat, and that, this effect continuing, the salt is entirely reduced. The second effect would be, according to M. Cedie, accompanied by a disengagement of nitrous gas, an idea which he grounds on the destruction of the characters of a paper ticket placed in the upper part of the vessel where he keeps the citrine ointment. This gentleman remarks, and with good reason, that the mode of action of recently prepared ointment, and that of long standing, cannot be the same, and he draws the attention of practitioners to this point.†

ELASTIC FLUIDS EVOLVED FROM VOLCANOS.

M. Boussingault having examined the gases emitted from many of the volcanos near the equator, has arrived at the following conclusions:—

1st. That the elastic fluids disengaged from the volcanos near the equator, are the same in the different volcanos; viz. vapour of water in great quantity; carbonic acid gas, sulphuretted hydrogen gas, and sometimes the vapour of sulphur.

2ndly. That the sulphurous acid and azote, which are met with in the craters of these volcanos, are to be considered as accidental substances.

3rdly. That muriatic acid, hydrogen, and azote are not among the gases disengaged from the volcanos at the equator.‡

* Traite de Chimie. † Journal de Pharmacie.

‡ Annales de Chimie.

PROPERTIES OF VAPOUR.

On December 20, 1832, at the Royal Society, a paper was read on this subject by the Rev. Dionysius Lardner, LL.D. F.R.S.

It has been generally supposed, that if a certain volume of aqueous vapour, contained in a vessel that was incapable of transmitting heat, were compressed by an exterior force into a space sufficiently small, a part of it would be restored to the liquid state. The author considers this assumption to be at variance with the doctrine of latent heat, and inconsistent with the results deduced from the experiments which have established that the absolute quantities of heat necessary to convert a given weight of water into steam, under all pressures, are sensibly equal. It follows, from this principle, that steam raised from water, under any pressure whatever, admits of indefinite compression and expansion, without returning to the liquid state. The effect of its compression will be to evolve heat and raise the temperature; that of its expansion, to absorb heat and lower the temperature: but in every state of density it will have exactly that temperature which it would have were it immediately raised from water under the pressure which it has acquired by compression or expansion. The only cause of the restoration of vapour to the liquid form is the abstraction of heat from it; and this cause will be equally operative, whatever may be the state of the vapour with respect to density; but compression alone, without such abstraction of redundant heat, can never convert any portion of vapour into a liquid. In accordance with these views, the author regards the permanent gases as vapours, containing a large quantity of redundant heat.*

CHEMICAL CHANGES OF COLOUR.

By H. F. Talbot, Esq. M.P. F.R.S.

Very little is known with certainty concerning the cause of those striking changes of colour which we so frequently witness in chemical experiments. No theory has yet been proposed which will by any means account for the whole of them, and we are often at a loss even for a plausible explanation. And yet these phenomena have probably some very close connexion with the ultimate constitution of bodies, and are therefore well worthy of our particular attention. I will therefore mention a few facts relating to this subject, hoping to engage others to pursue such inquiries further.

Water, being a colourless substance, ought, one would imagine, when mixed with other substances possessing no decided colour, to produce a colourless compound. Nevertheless it is to water only that the common vitriol or sulphate of copper owes its extremely vivid blueness; as is plainly evinced by a simple

* Philosophical Magazine.

experiment. For if we calcine the vitriol at a low red heat, and pulverize it, we shall obtain a powder of a dull and dirty white appearance. Now pour a little water upon this, and a slight hissing noise is heard, accompanied by an evolution of heat, very similar to what happens in the slaking of quick-lime. At the same moment *the blue colour suddenly reappears.* Dr. Faraday, to whom I showed this experiment, informed me it was new to him.

Under the microscope this is a very pretty experiment, for the instant a drop of water is placed in contact with the vitriol, the amorphous powder is seen to shoot into blue prisms.

Are we then to infer that water has a tendency to communicate a blue rather than any other colour, to bodies in general? By no means; for in other instances its operation is exactly the reverse, and it is a *destroyer* instead of a *promoter* of blueness. For instance: sulphate of molybdenum is a liquid of a very rich dark blue, when sufficiently concentrated: but a very small portion of water suffices entirely to annihilate this blue tint, and to produce a mixture which is perfectly colourless. Thus the action of water upon the two metals copper and molybdenum is of an entirely opposite character. Instead of water if ammonia be used, the same contrast is seen still more strikingly. Another remarkable and well-known instance analogous to this is the muriate of cobalt, which is entirely deprived of its fine blue colour by a very slight admixture of water.

Muriate of copper is described in most books of chemistry as a liquid of a bright green colour. But how imperfect an account of it this is, will be seen from the following experiment:—If sulphate of copper and muriate of lime (dry, or only slightly damp,) be pulverized together in a mortar, muriate of copper is formed, *of a dark yellow colour,* or more frequently *of a yellowish brown.* If a few drops of water are now added, the yellow speedily changes to a bright green. If more water is added, the mixture becomes greenish blue, sky-blue, and finally colourless. If the water is evaporated by heat, the same colours reappear, in the reverse order.*

In Turner's Elements of Chemistry, it is said that nitric acid when containing a small portion of the orange nitrous gas, acquires a green tint; upon which he takes occasion to make the following remark (p. 193):—

"It is difficult to perceive how an orange-coloured liquid should give different shades of green and blue merely by being diluted."

Now the above-mentioned property of muriate of copper seems to furnish an instance that is very analogous.

* The *yellow* state of the muriate of copper is best exhibited by warming a sheet of paper on which letters have been written with it. The writing disappears again on cooling, because it absorbs the atmospheric moisture. The use of this salt as a sympathetic ink has been already mentioned by chemical writers.

The mere application of heat often produces great change of colour, which disappears again when the substance becomes cold. Red lead, vermilion, and white oxide of zinc are instances well known, and never accounted for. Another curious example is furnished by the sulphate of molybdenum, which when warmed changes its fine blue tint to a pale yellow, again reverting to the blue when cold.*

TEMPERATURE OF THERMAL WATERS.

M. Boussingault observes, in a paper on the temperature of the thermal waters of the Cordillera of the Andes, that the explanation proposed by Laplace, of the heat of mineral waters, is confirmed by a crowd of facts observed on different points of the Cordillera. M. Boussingault thought he remarked that in the chain of the coast of Venezuela, the temperature of those waters is as much less as their absolute height is greater. For example, the warm water of Las Trincheras, near Porto-Caballo, which is almost on a level with the sea, presents a temperature of 97° centigrade; that of the source of Mariara, at the elevation of 476 metres, is but 64°; and that of the source of Onoto, situate at an elevation of 702 metres, is but 44° 5. Yet in the vicinity of the volcanoes, this regularity is no longer observed in the decrease of the thermal waters. It appears that under this circumstance, the local cause producing the volcanic phenomena has a marked influence on the temperature of these waters. It becomes then very interesting to investigate whether the thermal sources have their origin near the volcanoes. To come at the solution of this question, it is necessary to submit to chemical analysis the mineral waters near the volcanoes, and particularly to seek whether the gases which they contain are the same as those found in the craters. If so, it would be a strong reason for supposing that the thermal waters have been in contact with the matters which exist in the volcanic fires, and determining the saline substances dissolved in the mineral waters would acquire a new degree of interest, since these salts must be considered as soluble products existing or formed in the interior of the volcanoes. After these considerations, the author has undertaken the analysis of the thermal waters, which he met with in his travels. The result of his researches is, that the gases existing in the thermal waters, adjoining volcanoes, are of the same nature as those found in the craters of these volcanoes, to wit, carbonic acid, and hydrosulphuric acid gases. Whence M. Boussingault concludes that it is probable that the warm waters of the trachytic (*trachytique*) country near the equator, owe their temperature to the subterraneous fires, and that it is quite natural to think that the salts dissolved, or contained in these waters, arise from the interior of the volcanoes.

* Philosophical Magazine.

The memoir of M. Boussingault concludes by some researches as to whether the temperature of the thermal waters of the Cordillera is subject to variation. The results of these observations give an affirmative solution.

In 1800 M. de Humboldt found the temperature of the source of Mariara at 59° 3 : in 1823 it was, according to the observations of MM. Boussingault and Rivero, at 64°. This difference of 5°, 3, cannot be attributed to an error of the instrument, for the thermometrical observations which these two travellers made at Guayra and at Caraccas, coincide perfectly with those of M. de Humboldt. On the other hand, the researches made by them on the temperature of the waters of Las Trincheras, are also in support of the same opinion. The waters of this source issue from two small basins placed by the side of each other, dug out in granite. The larger has a capacity of about two cubic feet. M. de Humboldt gives 92°, 2 for the temperature of Las Trincheras. Twenty three years after MM. Boussingault and Rivero ascertained that the temperature of one of the basins was 92°, 2, and that of the other 97°. These observations, as also those of M. de Humboldt, were made in the month of February. Thus, in the space of twenty-three years, it appears that the temperature of the sources of Mariara and of Las Trincheras was raised several degrees. The narrator remarks, that during the interval which separates the observations of M. de Humboldt from those of M. Boussingault, the entire coast of Venezuela was shaken by the great earthquake of the 26th March, 1812, which destroyed the city of Caraccas, and several of those situated in the eastern Cordillera.*

MAGNETO-ELECTRICITY.

On November 14, a steel magnet, brought to this country by the Count di Predivalli, and arranged by M. Pixii, of Paris, was exhibited at the Adelaide Street Gallery, under the superintendance of Mr. Watkins, of Charing Cross. This magnet, being placed vertically, was made to revolve beneath an armature of soft iron, which was stationary ; and it very rapidly decomposed water, first in a single tube, hydrogen gas being evolved from one wire connected with one pole of the armature, while oxygen gas was given off at the other, precisely as when the elements of water are disunited by galvanic agency. The mixed gases were then reconverted into water by the electric spark after the usual manner. Water was next decomposed, and the elements received in two tubes ; and it was observed that the proportions were, as near as possible, two to one, affording another proof of polar decomposition. Next was an experiment quite new in this country, namely, that of charging a Leyden jar with magneto-electricity ; the

* From the French.

truth of which was made evident by the aid of a delicate electroscope, the gold leaves of which very sensibly diverged.

Mr. Saxton then proceeded to operate with the large magnet constructed by him for the gallery. This magnet is arranged horizontally and fixed, the armature being made to rotate. This splendid apparatus attracted the universal admiration of the scientific company present, not only from the beautiful and extraordinary effects produced by it, but also from its very superior mechanical arrangement. It gave powerful shocks, brilliant sparks, heated a platinum wire red hot, and decomposed water; but the experimenter was not so fortunate in charging the jar as in the former instance, although there seems no doubt that it is capable of being effected by this magnet.*

POISONS OF THE ANCIENTS.

At a late conversazione at the College of Physicians, Sir Henry Halford read a curious paper, in which he investigated the causes of the death of certain celebrated characters of antiquity, with especial reference to the knowledge of poisons possessed by the ancients. Sylla, he observed, died, in consequence of the rupture of an internal abscess, through an excess of rage; which, according to Valerius Maximus, produced a violent vomiting of blood, and death. Crassus, the eminent lawyer and friend of Cicero, died of pleurisy; and Sir Henry remarked that the course of treatment for this disorder, prescribed by Celsus, and in use at the time—namely, bleeding, cupping, and blistering, was so similar to that pursued at the present day, that nothing was probably left undone that could have saved his valuable life. Pomponius Atticus, whom Cicero loved as a brother, and who was on friendly terms with all parties in the disturbed times in which he lived, was said to have died of a fistula in the loins; it was probably, Sir Henry thinks, a dysentery ending, as that disorder commonly does, in an affection of the lower bowels. He had recourse to starvation, a very common expedient amongst the Romans, and died in ten days, aged 77. The latter end of Socrates was brought about by the common mode of despatching persons capitally convicted at Athens, namely, by a narcotic poison: but neither Xenophon nor Plutarch tells us the species of poison. The poisons of this class known to the ancients were aconite, white poppy, hyoscyamus, and hemlock. The black poppy might be the Theban drug. The hyoscyamus was used at Constantinople, and was very likely the nepenthe spoken of by Homer. But most probably the poison administered to Socrates was the same as that given to other condemned criminals—namely, κονιον, *cicuta*, hemlock. Juvenal attributes his death to hemlock—

——— "Dulcique senex vicinus Hymetto,
Qui partem acceptæ sæva inter vincla cicutæ."

* Literary Gazette.

Whatever may have been the species of poison, it was one of weak and slow operation, for the executioner told Socrates that if he entered into earnest dispute it would prevent its effect; and it was sometimes necessary to repeat the dose three or four times. Its operation was gradually to produce insensibility, coldness of the extremities, and death. What was that poison by which Hannibal destroyed himself? It was improbable that we should ever know. Modern chemistry had discovered a variety of subtle poisons that might be introduced into a ring, and, under certain circumstances, destroy life. One drop of Prussic acid might produce paralysis, and, if taken into the stomach, would instantly arrest the current of life. But it was not likely that the Carthagenians were acquainted with Prussic acid; Lybia most probably produced poisons sufficiently subtle and destructive to accomplish the fatal purpose of Hannibal. As to the report of its being bullock's blood, that, Sir Henry observed, must be a fable, as well as in the case of the death of Themistocles, for it is well ascertained that the blood of that animal was not poison. An accomplished nobleman had told him (Sir H. Halford) that he had been present at a bull-fight in Spain, when, after the matador had killed the bull, a person ran up, caught the animal's blood in a goblet, and drank it off, as a popular remedy for a consumption. With respect to the poison with which Nero destroyed Britannicus, comparing the account given by Tacitus with the effects of laurel-water, Sir Henry was disposed to think that this was the identical drug. It appeared that the Emperor applied to Locusta, a female poisoner, to procure some vegetable poison that would kill speedily. She produced one which destroyed a goat in five hours. Nero, however, required a poison which would kill instantly, and she procured such an ingredient. At the banquet Britannicus called for water, which the *pregustator* tasted; it was not sufficiently cool; part was then poured off, and the fatal liquid added; the young man drank, was seized with an epileptic fit, and expired. The case, Sir Henry remarked, was analogous in the effects with that of Sir Theodosius Boughton, who was poisoned by Donallon with laurel-water, and fell down in an epilepsy. In the case of Britannicus, Nero told the company that the young man was liable to such fits; and in the other case, Donallan said that Sir Theodosius had been subject to fits from his infancy. Tacitus mentions a blackness which came over the body of Britannicus; and Sir Henry stated that he was present when the corpse of Sir Theodosius Boughton was disintered, and its colour resembled that of a pickled walnut. If we could suppose that the Romans were acquainted with the deleterious property of laurel-water, and with the process of distillation, there could be no difficulty in concluding that Britannicus was poisoned with laurel-water. It was true the species of *laurus* which yielded the deleterious liquid did not grow in Italy; but it was a native of Colchis, from whence it might have been brought.

The *laurus nobilis* (daphne) grew about Rome, and was used in producing the inspirations of the prophetic priestesses. As to the knowledge possessed by the Romans of the art of distillation, they had not indeed a still and refrigeratory like the moderns; but they received the vapour from the boiling herbs in a handful of sponge, which, though a rude, was not an inefficient substitute. Alexander the Great had been said to have been poisoned; but this was inconsistent with the very detailed account of his illness given by Arrian. The report was that the poison was sent by Antiphon, and was of such a peculiar nature that no silver or metallic substance would contain it, and it was conveyed in the hoof of a mule. But the article was really onyx, as Horace—

"Nardi parvus onyx;"

Now, the word *onyx*, in Greek, signified not only a stone, but *unguis*, a hoof or nail; and the second sense had been evidently given instead of that of a precious stone. This double meaning of the term *onyx* explained the account of poison being retained by persons in their *nails*. Alexander really died of a remittent fever caught at Babylon. As to the cause of it, Arrian expressly states that the King was temperate and forbearing in the pleasures of the table; and when we consider the laborious occupations of Alexander, amidst frost and snow, and especially the marsh miasmata of the Babylonian lakes, Sir Henry thought there was no difficulty in conceiving that this was too much even for his frame of adamant. The diary of Arrian, containing the details of Alexander's illness and death, vindicated his memory from the imputation of his having brought on his fate by intemperance. Sir Henry Halford closed his learned and interesting paper by a brief encomium upon the character of Alexander, in the course of which he remarked that the efficiency of the British army in India, which kept millions of natives in subjection, was maintained by the same measures which Alexander devised and executed.*

GENERAL SCIENCE.

CONSTANTS OF NATURE AND ART.

At the meeting of the British Association, held in July, at Cambridge, Mr. Babbage enforced the great advantage which would result from devising a collection of numbers, which should serve as *Constants* in defining all facts in nature and art; which im-

* Times.

portant proposition Mr. Babbage has illustrated in the following paper.

Amongst those works of science which are too large and too laborious for individual efforts, and are, therefore, fit objects to be undertaken by united academies, I wish to point out one which seems eminently necessary at the present time, and which would be of the greatest advantage to all classes of the scientific world. I would propose that its title should be "The Constants of Nature and of Art." It ought to contain all those facts which can be expressed by numbers in the various sciences and arts. A better idea will be formed by giving an outline of its proposed contents, and it may, perhaps be useful to indicate the sources whence much of the information may be drawn. These constants should consist of—

1. All the constant quantities belonging to our system; as distance of each planet, period of revolution, inclination of orbits, &c., proportion of light received from sun, force of gravity on surface of each. These need not be further enumerated, as they have already been collected, and need only be copied.

2. The atomic weights of bodies. These may be taken from Berzelius, Thomson, or Turner. The proportions of the elements of various compounds—acids with bases, metals with oxygen, &c. These may be taken from the best treatises on chemistry.

3. A list of the metals, with columns containing specific gravity, elasticity, tenacity, specific heat, conducting power of heat, conducting power of electricity, melting point, refracted power, proportion of rays reflected out of 1000, at an incidence of 90°.

4. List of specific gravities of all bodies.

5. List of refractive indices, dispersive indices, polarizing angles, angles formed by the axes of double refraction in crystals. These may be extracted from the writings of Brewster, Mitscherlitch, Herschel, Biot.

6. Number of known species of mammalia, birds, reptiles, fishes, mollusca, worms, crustacea, insects, zoophytes. These classes might be further subdivided. Additional columns should show how many of each are found in a fossil state, and the proportion between the fossils of existing and extinct species.

7. List of mammalia, containing columns expressing height, length, weight, weight of skeleton, weight of each bone, its greatest length, its smallest circumference, its specific gravity; also the number of young at a birth, the number of pulsations per minute whilst the animal is in repose, the number of inspirations in the same circumstances, period of blindness after birth, period of sucking, period of maturity, temperature, average duration of life, proportion of males to females produced. It would be desirable to select some bone for the unity of weight, and perhaps of measure, and to give the proportion of all the other bones to this standard one. The numerical relations thus established might, perhaps, in some cases, identify the sexes, or even the races of the human species, when only a few bones were found. It would also be highly interesting to compare the relative weight of the bones of persons employed in different trades, and of persons dying from certain constitutional diseases.

8. Of man—average weight at various periods of existence, height of ditto, tables of mortality in various places, average duration of reigns of sovereigns, proportions of the sexes born under various circumstances, proportion of marriages under various circumstances, quantity of air consumed per hour, quantity of food necessary for daily support, average

portion of sickness amongst working classes, proportion of persons dying from different diseases. Many of these facts may be found in the writings of Villermé, Quetelet, Baily, Milne, &c.

9. Power of man and animals. A man labouriug ten hours per day will saw ( ) square feet of deal, ditto ( ) elm, ditto ( ) oak, &c., ditto Portland stone, ditto Purbeck; day's labour in mowing, ploughing, &c. &c.; every kind of labour; raising water one foot high; horse ditto, ox or cow ditto, camel. Power of steam-engines in Cornwall. Inclination of a road, both in degrees and number of feet, &c., or of a base on which carriages and horses can trot, walk, on which horses cannot ascend, on which man cannot, on which a cart cannot ascend.

10. Vegetable kingdom—number of species known of monocotyledonous plants, number of species of dicotyledonous plants. Number of species of the various natural groups. Additional columns should show the number of species known in a fossil state together with fossil. Also average weight of vegetable produce of one acre in a year, when under different modes of cultivation, hay, straw, wheat, turnips, and mangel-wurzel, potatoes, clover, &c.; produce of timber per acre.

11. Tables of the geographical distribution of animals and of plants, of the average period of maturity and decay in various woods, increase in weight annually at different periods, weight of potash produced from each, proportion of heat produced by burning given weight.

12. Atmospheric phenomena. Weight of air above a square inch, square foot, an acre, a square mile of the earth's surface, barometer at 30 in. Weight of oxygen, of nitrogen, of carbonic acid, above the same spaces, under the same circumstances. Weight of water in vapour above ditto at various degrees of hygrometer. Depth of rain falling annually at various places, in inches; columns for number of years' observation; mean temperature; mean height of barometer; height of places above the sea; drainage of surface-water for one, two, three, to ten inches, from each square of 100 feet side, each acre, or square mile, expressed in cubic feet, in gallons, and in hogsheads; water discharged per 1″ or 1′, per hour, or per day, under various circumstances, as found by experiment; velocity of rivers and torrents to carry stones of given weight.

13. Materials—height to which a column of any substance used in building may be carried before the lowest layer is crushed, weight necessary to crush a cubic inch of each, weight of cubic foot or cubic yard. Angles at which sand, gravel of various sized pebbles, snow, &c. support themselves. Strength necessary to pull asunder various woods, bars of metal of various dimensions, weight to break ropes and chains of various sizes, column for weight to be safely borne by them, friction under various circumstances, resistance of fluids. Weight of coal to burn ten bushels of lime, weight of ashes to burn 10,000 bricks, of coke to make a ton of wrought iron, tallow to make soap, &c., and constants in all trades. See Rennie, Tredgold, Prony, Eytelwein, Venturi, &c.

14. Velocities—arrow, musket-ball at several distances, cannon-ball, sound, telegraph, light, birds. Day's journey. Man, horse, heavy wagon, stage-coach, mail-coach, camel, elephant, steam-carriage, steam-boat, balloon, greatest, average passage Liverpool to New York, &c.; of steam-boats, Dublin to Liverpool, London to Edinburgh, &c.

15. Length of all rivers, water discharged per hour; seas, proportion of water to land on globe, area of all seas and lakes in square miles, areas of all islands and peninsulas and continents, heights of mountains, depth of mines from surface, quantity of water pumped out of mines. Heights

of above 7,000 points in Europe may be found in Oragraphie, the third volume of the "Transactions of the Geographical Society of Paris."

16. Population, extent in square miles, revenue, &c. of kingdoms; births, deaths, marriages, rate of increase, population of great towns.

17. Buildings—height of all temples, pyramids, churches, towers, columns, &c.; also all single stones, as obelisks, and area covered by ditto, area of all great public buildings. Dimensions of all columns in ancient temples, length of all bridges, of span of each arch and height, also breadth of piers. Such tables may be found in Wiebeking, "Architecture Civile," &c.

18. Weights, measures, &c.—factors and their logarithms to convert all money of every country into English pounds sterling; ditto to convert weights of every country into English pounds avoirdupois; ditto foot and ell measures in every country into English feet; ditto measures of area, acres, &c. into English acres; ditto liquid measures in every country into English imperial gallons. These are already collected in several works of Löhmann of Dresden. See also "Universal Cambist."

19. Tables of the frequency of occurrence of the various letters of the alphabet in different languages,—of the frequency of occurrence of the same letters at the beginnings or endings of words,—as the second or as the penultimate letters of words,—of the number of double letters occuring in different languages,—of the proportion of letters commencing sirnames amongst different nations. See Quetelet. *Journal*, also *Dissertatio inauguralis Mathematica de literarum proportionibus*, F. J. Adelmann, Bruxelles, 1829.

20. Table of number of books in great public libraries at given dates,—number of students at various universities. Observatories of the world,—Transit, length of diameter of object-glass, maker,—Circle, length of telescope, aperture, diameter of divided circle, maker. It would be desirable to give the date of the different eras by which time is computed, and perhaps tables of the reigns of sovereigns. Also a chronological table, at least of scientific discoveries and their authors. In the above enumeration, which is far from complete, some few of the uses of such a volume are noticed, others will present themselves to every reader, and probably many unexpected ones will arise. The facts being all expressed in number, if printed in a small type and well arranged, would not occupy a large space. Most of the constants mentioned in this list already exist, and the difficulty of collecting them would consist chiefly in a judicious selection of those which deserved the greatest confidence. The labour of extracting them from a great variety of volumes, and of reducing the weights and measures of other countries to our own, could be performed by clerks. To any individual who might attempt it, it must be a work of great labour and difficulty, and there are few persons possessing the varied knowledge which such a task implies, whose talents might not be differently employed with more advantage to science. It is also certain that such an assemblage of facts, emanating from the collected judgment of many, would naturally command greater attention than if it were the produce of any single individual, however eminent. It appears, then, that such a work is particularly fitted to be the production of a body of men of science; and I would appeal to the great academies of Europe whether they would not, by combining in one volume so vast a collection of facts, confer an important advantage upon science and upon all who are occupied with its pursuits. I would suggest that three of the academies of Europe, perhaps the Royal Society, the Institute of France, and the

Academy of Berlin, should each publish, at intervals of six years, their own table of the CONSTANTS OF NATURE AND ART. Thus these publications might succeed each other at intervals of two years, and the man of science would always be able to refer to the most recent determinations of the Constants he employs. In order to execute the work, sub-committees of one or two persons must be appointed to each department; who should be directed in the first instance to prepare the outline of the constants they propose to insert. These views should then be considered and classed by a small committee, consisting of persons of general views and of various knowledge. The sub-committee should then collect and reduce to certain standards the constants committed to them, and the whole should be printed under the general superintendence of the committee, but each part should be specially revised by its own sub-committee. A preface should be prepared, stating as shortly as possible the reasons for prefering or rejecting particular experiments or observations, and also, generally, the degree of accuracy the several subjects admit of. A good and concise system of references should be made to all the authorities for the numbers given. Whoever should undertake the first work of this kind would necessarily produce it imperfect; partly from omission, and partly from the many facts connected with natural history, which, although measured by number, have not yet been counted. But this very deficiency furnishes an important argument in favour of the attempt. It would be desirable to insert the heads of many columns, although not a single number could be placed within them; for they would thus point out many an unreaped field within our reach, which requires but the arm of the labourer to gather its produce into the granary of science. It is, however, to be hoped that no fear of the imperfection of a first attempt will deter either any individual or any body of men from an immediate endeavour to produce a work fraught with so many advantages to knowledge. The task of revising it at each period of six years will be comparatively easy, and the discussions of new observations or additional experiments made during those intervals, will have an admirable effect in exciting the ambition of the inquirers, to bestow such care as shall claim for their results a place in the volume, in which the academy shall record the condensed expression of the knowledge of their age and nation. If I should be successful in inducing any scientific academy to enter into the task, I am confident that many a weary hour, now wasted in the search for existing knowledge, will be devoted to the creation of new, and that it will thus call into action a permanent cause of advancement towards truth, continually leading to the more accurate determination of established facts, and to the discovery and measurement of new ones.''*

The sum of one hundred pounds was subsequently voted towards the execution of this important labour.

SCIENTIFIC EDUCATION.

ON February 15, at the Royal Institution, Professor Ritchie read an interesting discourse on a peculiar mode of communicating scientific knowledge to youth.

Dr. Ritchie stated, that to give effect to any system, the teacher must possess certain qualifications. Among these must be an

* From the Report of the Proceedings of the Association, in the Literary Gazette.

accurate knowledge, not only of the particular branch which he teaches, but also of collateral subjects, that he may be able to draw his illustrations from the most interesting sources. In order to give a boy some confidence in his own strength, the teacher should carefully avoid using any epithet which might lead the boy to believe that he was stupid—the term "Dunce" ought not to be known in schools.

The plan usually adopted in teaching elementary science in schools, is the synthetical mode of instruction. The plan recommended as having been found most successful, is strictly analytical. In arithmetic, for example, a system of rules is placed before the pupil, and he is told to do a certain number of sums by those rules. When the boy has succeeded in doing so he receives praise, and believes he has done all that is necessary, whereas he has scarcely done anything. He sees not the principle on which the rule is founded. His reasoning powers have scarcely been called into exercise. His memory is thus burthened with a load of rules without one connecting principle. It is a very common observation with a boy, when he cannot solve a question in arithmetic, that he has forgot the rule. Had he got principles instead of rules, arithmetic would have become as it were a part of himself. He could no more forget these principles than he could forget his own name.

When a boy has obtained an accurate view of the great leading principles of arithmetic, which may be attained in a few months, he should be gradually led on to geometry. The ordinary mode of teaching geometry in schools is to place the Elements of Euclid in his hands. Now this work, notwithstanding its many excellencies, is not well adapted to the instruction of boys. The demonstrations are too verbose and perhaps too formal for youth; and the arrangement, however logical, is not the arrangement according to increasing difficulty of solution, which ought to be the arrangement for instruction: besides, it is entirely synthetical. Reading Euclid, as it is called, may improve the memory, and give a sort of mathematical precision to the language, but it certainly does not bring into play the reasoning and inventive faculties of youth. The analytical mode constantly employs the reasoning powers, and is the only mode which can rouse the dormant inventive powers of youth.

Boys are always anxious to see the use of what they learn. Now this may be done from the very commencement of their geometrical studies. Let them be taken out to the fields and shown the applications by taking the angles subtended by distant objects, which may be accomplished by means of very simple instruments that can be made for a few shillings. By taking a few angles, and measuring, by means of a tape or chain, a few lines, the boys would be delighted to construct the figure by means of their protractor and diagonal scales, and thus to ascertain by measurement the distances of remote objects, &c.*

* Philosophical Magazine.

NATURAL HISTORY.

ZOOLOGY.

THE EEL AND THE WHALE.

One of the most interesting papers at the Second Meeting of the British Association was that by Mr. Yarrel, on the generation of the eel, which is about to appear in a second series of Mr. Jesse's delightful Gleanings in Natural History.

This *vexata quæstio*, which has occupied the attention of naturalists from Aristotle downwards, has been at last set at rest by Mr. Yarrel, who has proved, by actual examinations, and dissections carried on through eighteen months in succession, upon specimens of eels procured from different parts of the country, that it is oviparous—having melt and roe, like other fishes. He has traced them down to the brackish water, whither they go generally, though not universally, to deposit their spawn; and he has followed the young in their extraordinary spring journeys up the great rivers and into the brooks and rivulets, in which they seek out for themselves appropriate haunts. In numbers they are immensurable—the shoals advance up the stream, forming a black line along the shore; nor are these journeys confined to the water—they cross fields, and climb posts and pales, in order to reach the place of their destination.

On the same day, the Rev. Mr. Scoresby laid open some of his store—his vast experience of the natural history of the northern regions—a short account of the whale, got up extempore, as he acknowledged, but, perhaps, even more interesting because unpremeditated.

The most surprising fact in the history of the whale, probably, is his power of descending to enormous depths below the surface of the sea, and sustaining that almost inconceivable pressure of the superincumbent water. On one occasion which fell under Mr. S.'s own observation, a whale was struck from a boat. The animal instantly descended, dragging down with it a rope very nearly *one mile long*. Having let out thus much of rope, the situation of the boat's crew became critical—either they must have cut the line, and submitted to a very serious loss, or have run the risk of being dragged under water by the whale. The men were desired to retire to the stern, to counterbalance the pulls of the whale, which dragged the bow down sometimes to within an inch of the water. In this dangerous dilemma the boat

remained some time, vibrating up and down with the tugs of the monster, but never moving from the place where it lay when the harpoon was first thrown. This fact proves that the whale must have descended at once perpendicularly, as had he advanced in any direction, he must have pulled the boat along with him. Mr. S. and the crew were rescued by the timely arrival of another boat, furnished with fresh ropes and harpoons.

Mr. S. calculated that the pressure upon the whale's body, sunk a mile below the surface of the sea, must have equalled the enormous weight of fifteen tons to a square inch. We state this from recollection only, but are tolerably sure of the accuracy of the statement.

The whole structure of the whale exhibits most admirable adaptation to its situations and the element in which it lives—in the toughness and thickness of its skin, and disposition of the coating of blubber beneath, which serves the purpose—if we may be permitted to use so homely a simile—of an extra great-coat to keep him warm, and prevent his warm, red blood from being chilled by those icy seas. But provision is especially made to enable him to descend uninjured to very great depths. The orifices of the nostrils are closed by valves wonderfully suited to keep out the water from the lungs, and withstanding the pressure. In one species they are shaped like cones, which fit into the orifice like corks in the neck of a bottle, and the greater the pressure the tighter they hold.

In representations of the whale, we always see two spouts of water mounting into the air from his nostrils, like artificial fountains. This is occasioned merely by the mode in which the animal breathes; and it is an error to suppose that it ejects the water out of his mouth through his nostrils. It is merely their breath which they discharge, intermixed with mucous matter, and perhaps the foam of a wave which may happen to dash over them. These vapoury jets look like smoke at a distance, and are sometimes driven upwards to a height of several yards.*

NORTHERN BIRDS.

On the Youth—Age—Diseases—Sleep, and Death of Northern Birds.

By FREDERIC FABER.

IN tracing the gradual developement of birds from the egg to the period of puberty, we find that the time of youth, or their unfruitful age, lasts but a short time, as many species breed the very next spring. If we assume that, as well as the mammalia, the period of their existence bears to that of their growth the proportion of five to one, they reach, as far as we know, a very advanced age. It is impossible to give correctly the maximum which each species attains, and I shall not attempt to investigate

* Literary Gazette.

it with regard to the northern birds, for the results would be too vague to excite much interest. The reason of the difficulty in determining precisely the age of birds, is in the impossibility to trace a bird from its birth to its death, except in the case of tame birds, which live a much shorter time than the same species would doubtless do in the wild state, and partly from the advanced age of birds being marked out by no striking phenomenon, and that most of them become a prey to enemies before reaching the natural limits of existence.

As far as we know, the larger birds live longer than the smaller. In all, the length of their lives is in direct proportion to that of their unfruitful period, that species living longest which is latest in arriving at maturity. We have some positive observations on this head. The great age of the eagle is well known: it amounts even to a hundred years, and is several years before breeding. I am acquainted with an instance of a tame fishing eagle, which was taken in the year 1806 out of the nest, and in its tenth year had not received the white tail characteristic of the breeding state. Olafsen notices two eider-ducks, which returned for twenty years to the same breeding-place. The male of this species spends also four or five years in its unfruitful state. Those species to which the inhabitants of the north attribute a high age, are all more than a single year before breeding, as the *Colymbus glacialis, Cygnus musicus, Sula alba, Falco islandicus.* But certainly the age of the swan and the raven is placed too high when estimated at a hundred years.

According to the ideas which I have on the age of northern birds, and which scarcely admit of being precisely demonstrated, the unfruitful period in those species which are several years of propagating their kind, is to the whole life as one to ten. Upon this principle, the fishing eagle would live a hundred years, being ten years unfruitful; the male eider-duck forty years, being four years in the young plumage; *Laurus glaucus, marinus, Leucopterus tridactylus, Sula alba,* or solan-goose, and *Cephus grylle,* thirty years; *Lestris, Anas clangula, glacialis, histrionica,* twenty years, &c. This proportion seems to hold in those smaller species which are only one year before breeding, as the singing tribes, for these little birds scarcely exceed an age of ten years. In the larger species, however, which are only one year of reaching puberty, as most of the Grallæ and of the Palmipedes, the guillemot (*Uria*), auk (*Alca*), *Mormon,* the near proportion seems to be as one to twenty, which increases or diminishes according as the bird is larger or smaller. It is evident that aquatic birds live long in proportion to their short youth, from the immense number of individuals in the north, although most of the species are monagamous so exclusively, that both male and female share the labours of hatching, &c. when there is but one fruitful egg for a whole summer; and more than the half of the species which breed in Iceland, and of the young

birds, are annually taken away by the inhabitants. More than 20,000 or 30,000 young of the Fulmar (*Procellaria glacialis,*) are annually taken on the Westmannoe Islands alone, which must be the product of from 40,000 to 60,000 old ones, without their numbers suffering any apparent diminution. And although the majority of the young (*Mormon fratercula*) are every year taken from the holes, as well as numbers of the adults, yet every year the rocks are covered with birds, as if nothing had happened. The same is the case with the *Uria Brunnichii, troile,* razorbill (*Alca torda*), and *Larus tridactylus,* on Grimsoe; with the eider-duck on Widæe; and the other species of *Anas* at Myvatn, which seem in fact yearly to increase in numbers, although regularly the natives fill several boat-loads with their eggs. It would be impossible, in these circumstances, to preserve the species, if the same individul did not continue to propagate its species for a long succession of years.

We have just observed that the advance of old age in birds is marked by no peculiar appearances. In many of the mammalia, as the horse, the hair becomes white with age, or falls out altogether, as I have seen in the *Phoca barbata.* The teeth become blunted, which is a mean of recognising the age of many of our domestic animals. Such does not happen with old birds; their feathers retain the hues which they possess in the adult state; nor do their bill or claws become perceptibly blunter. Some ornithologists even maintain that the unusually white colour of some individuals, in species where this is not the hue, is a sign of old age, or at least of their being beyond the age for propagation. I cannot, however, concur in this idea, but think that it is not a variety depending upon age, but a regular albino. The white varieties of the buzzard, swallow, and starling, exist even in the young while in the nest. Horrebow asserts the same of the Iceland falcon, in his Account of Iceland, p. 148, and many of the natives have maintained the truth of the fact. The white-bellied parasitic *Lestris,* is not an older variety of the brown-bellied, but both these colours are found even in the nest. The same is the case with the white magpie, and the white cormorant of the Faroe Isles; and certainly so with the Rotche (*Uria alle,*) Tyste (*Cephus grylle*), and *Anas histrionica,* in Greenland. But although the tint of colour does not alter with age, the lustre of the feathers diminishes in the males, and the appendages of the feathers when they occur elongate. The older the heron, the longer is his beard. It is the same with the lapwing, with the collar in the *Podiceps* and *Charadrius,* and with the long tail feathers of the Arctic gull (*Lestrsi parasitica*), *Anas glacialis* and *acuta.* It is, therefore, very uncertain to estimate the age of birds by the length of these parts. When the female as well as the male is provided with these ornaments, they also lengthen with age. There is, however, one appearance in the female indicative of an advanced age. When the sexes

are of different colours, as in some gallinaceous birds, when they cease to lay eggs, assuming the splendid plumage of the male, as the young male at first resembles the female. I have also seen old females of the *Mergus merganser* and *serrator*, *Anas glacilis*, *histrionica*, and *crecca*, with somewhat of the plumage of the male.

Disease does not seem to characterize the old age of birds. In the wild state, they are seldom affected by sickness, and certainly by no regular debility. Only whilst moulting they are sluggish, depressed, and conceal themselves; but this change is in the wild state, seldom mortal. There is no doubt that the young eider-duck is often preyed upon by a growth in the abdomen, about the size of a goose's egg; and the *Uria troile* and *Brunnichii* are often in winter exhausted by some unknown weakness, and found dead on the sea-shore. In certain years, the *Sula alba* seems to be subject to a contagious disease, and then is thrown up in great numbers on the coast of Iceland. Otherwise the northern birds are only subject to disease, except such as are brought on by accidental causes, as when their legs are frost-bitten, or frozen to the ice, as often happens with the *Alca torda*, *Uria troile*, *Brunnichii* and *alle*; or when their wings are broken in a storm, of which I have seen an example in the *Procellari glacialis*; and when they are sometimes famished with hunger. It is characteristic of the Palmipedes, that those species which spend their whole lives at sea, and scarcely ever leave the water, without exception, seek the land when they are sick, where they end their lives on the same medium in which they commenced them, although, during the whole interval, they shunned it as much as possible. It is accordingly the best proof of the *Uria*, *Colymbus*, eider-duck, &c. being sick, when they are seen to approach the shore, and repeatedly endeavouring to gain it, although they should be driven back.

A disease which affects most water birds, is an enormous accumulation of intestinal worms. This, however, seems to give them as little annoyance as it does the seal, especially the *Phoca barbata*, the whole of whose stomach is often studded with ascaridæ. I have found in the stomach of the *Mormon fratercula*, a small ball of grey convoluted ascaridæ, without the individual being at all emaciated; and rarely do we open a *Uria*, *Cephus*, or *Alca*, without finding in the intestines, either tæniæ or ascaridæ. In an excursion to some of the Danish Islands, in the summer of 1824 and 1825, I found the intestine of the *Podiceps subcristatus* filled with tæniæ, the largest of which was twelve inches long, and yet the bird was fat and healthy. Several of the northern birds appear to suffer from external parasitic animals, especially from lice, which, at the breeding season, swarm in the bird-cliffs and their nests. Each bird has a species of vermin peculiar to itself. None are so much molested by them as the *Uria troile* and *Mormon fratercula*, in which the animal is

broad, flat, and blue, nearly the size of the sheep's louse, and sucks with great vigour. The lice of the *Sula* and *Carbo* are long, slender, and proportionally small, much smaller than the human louse. In other species, as the *Larus* and *Corvus*, they are still smaller, and resemble mites.

Birds manifest indisposition by sleepiness, hanging feathers, loss of appetite, emaciation, and by putting their heads constantly under their wings; and they end their existence with a few convulsive struggles and movements of their wings. There are no other phenomena accompanying their *Death*. Of some northern birds, as the musical swan, it is a common saying, that it announces its death by melodious notes, which have been called the swan's death-song. This, however, is entirely the creature of the fancy of a southern poet, and while it is repeated in the writings of the learned, it is quite unknown to the nations among whom the *Cygnus musicus* lives and dies. I have never heard the Icelanders hint in the least that this bird emitted any sound at its death. The opinion takes its origin from the harmonious trumpet-like sounds which issue from its complicated wind-pipe when it flies high in the air, and from which it has obtained its trivial name. As it is chiefly heard in clear moonlight nights, these sounds may excite the fancy, in the same way that the nocturnal sounds of the wild owl have given rise to the story of the hunting of King Waldemar, or the Wild Hunter.

Most birds, however, die neither of age nor disease, but become a prey to their *enemies*. It is wisely provided by nature, that one animal should prey upon another, that their carrion might not contaminate the air, nor their reproduction be disproportionate to their means of subsistence. Yet, on land, this mutual murder is by no means carried on to the same extent as at sea. Birds are not in the north so much exposed to birds of prey as in more temperate countries. In Iceland, there are only three proper rapacious species, with the exception of some of the omnivorous forest and aquatic birds, which occasionally become true birds of prey, as the raven, which attacks ptarmigans and pigeons; *Larus marinus*, which attacks sick, and *Lestris cataractes*, even vigorous, birds; *Lestris parasitica*, which preys on eggs, &c. The polar fox is their most active enemy among the mammalia; and a solitary *Uria* or *Alca*, when diving to the bottom of the sea, may be snapped up by the sea-horse. Man, however, is their most dangerous enemy, who, taking advantage of their tameness and sociability at the breeding time, every year destroys a greater number of individuals than all their other enemies taken together.

When birds are aware of danger, they are affected with *Fear*, and being destitute of the moral self-command given by reason, they take refuge in flight when it is not necessary for their safety. They sometimes manifest alarm by a cry which, in some domestic birds, as the singing tribes, the swallow and siskin, is quite

peculiar. But few species have sufficient confidence in their physical powers, to attempt self-defence, when they are conscious of the superiority of their foe. This, however, is done by some of the Accipitres, as well as different Grallæ and Palmipedes, as the lapwing, gull, sea-swallow, when they have young. Therefore, birds of prey are not so dangerous to man as quadrupeds, as the wolf, the bear, &c. When they cannot escape, however, even pusillanimous birds defend themselves, the same as the most cowardly man fights when all retreat is cut off. Thus, the little singing birds bite the finger of the person who catches them, and gulls or ducks which have been shot in the wing, endeavour to free themselves by pecking at the fingers of the hunter. Only the wading birds, provided with a long and soft bill, as the snipe, attempt no resistance when taken. The innate hatred which other birds bear to the Accipitres, is seen by some of the best fliers, when they could easily escape by flight, overcome by their fears, pursuing them with cries and provocations. Thus the swallow, raven, crow, lapwing, sea-swallow, whenever they see a rapacious bird, immediately fly after him and pursue him with loud cries in the air.

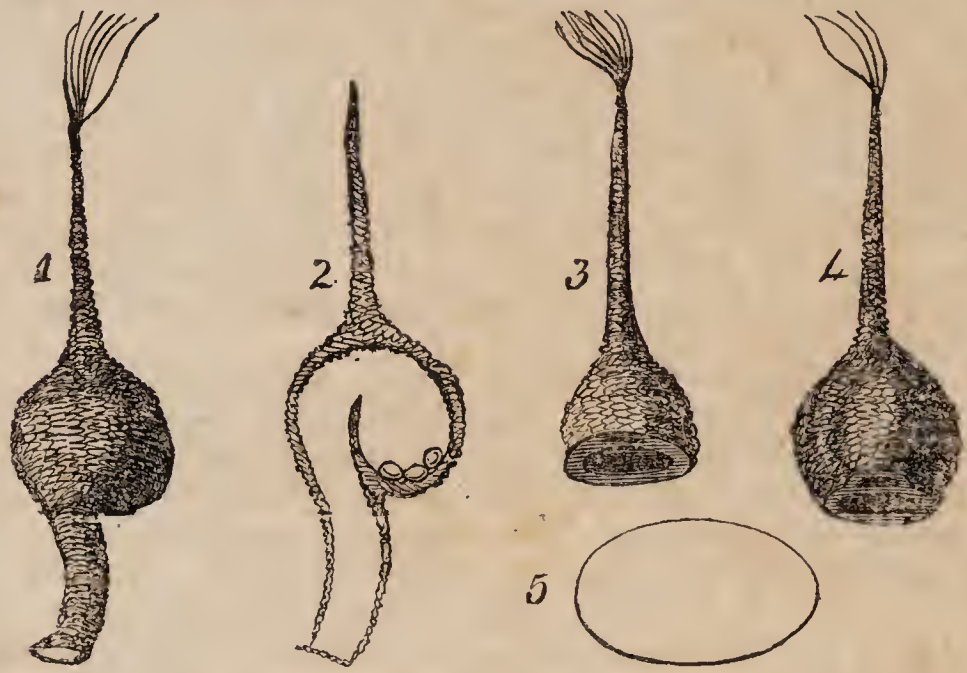
I have already, on different occasions, noticed the *Repose* and *Sleep* of the northern birds. Most sleep in the dark, only a few, as some owls and the *Puffinus*, are true nocturnal birds. Some species, however, which, at other times, are true diurnal birds, migrate in the night-time. The ducks, in particular, are constantly in movement on the clear moonlight nights. The bittern, *Limosa melanura*, *Gallinula crex*, and nightingale, prefer emitting their noise in the twilight; and gulls and lapwings often cry in the night-time. With these exceptions, darkness is the signal for a universal stillness in the ornithological world. In the northern regions, therefore, the duration of their sleep varies very much with the seasons, as in summer they scarcely sleep one or two hours, and in winter more than sixteen or eighteen hours. The long winter's sleep, and the consequent inferior degree of locomotion, and diminished appetite, are all in accordance with the scanty products for their subsistance in the polar regions at that season. Birds give a preference to certain breeding places. Some species hardly sleep at all, as the *Sula alba;* others very easily, as the *Anas*. Some prefer the water, as the Diver (*Colymbus*), and Grebe (*Podiceps*); others the land, as the land birds, Tern (*Sterna*), Heron (*Ardea*), Plover (*Charadrius*), Oyster-catcher (*Hæmadopus*); others prefer flying, as the species which perch on trees; others partly standing, partly flying, as the Duck (*Anas*), Swan (*Cygnus*); some during sleep conceal the head beneath the wing. On break of day, all are in immediate action; the singing birds salute the rising sun with their notes,—the Accipitres begin to hunt—the Grallæ to run about,—and the Palmipedes to retire from the land into the sea.*

* Jameson's Journal.

ON THE PENDULOUS NESTS OF THE INDIAN BAYA BIRD (LOXIA PHILIPPINA L.)

By a Correspondent of the Magazine of Natural History.

As the descriptions, even in modern publications, of the pendulous nest of the Indian baya (Loxia philippina *L.*) give no very definite idea of its form, I send a rough sketch (1) of one of the most perfect I ever happened to notice, with a section (2) to show its interior arrangement; and sketches (3, 4). from recollection, of one in progress of being built: the figures are one tenth of the natural size, the extreme length being 15 in. The



materials are usually fibres of the fronds of the palmyra (Borassus flabelliformis *L.*), cocoa nut palm (*Cocos* nucifera *L.*), and wild date of India (*E*late sylvestris *L.*), sometimes mixed with grass, and occasionally made entirely of grass where palms are not to be found: these are neatly interlaced, and form a texture of extraordinary strength. The nest is suspended as represented in the sketch: if from a palm, from the tip of a frond; and if from any other tree, from the extremity of a slender branch, those overhanging water being always preferred. It will be seen by the section (2) that it consists of only one chamber, with a long tubular passage leading to it; and I am at a loss to imagine what could have given rise to the idea of two or three separate apartments, unless, indeed, it may have been a hasty glance at the half-finished nests: new ones are never added to the old. I have often heard, from natives of India, of the baya's lighting up its nest with fire-flies, but never myself had an opportunity of noticing it. The pipe forming the entrance is seldom so long as here represented: it often does not pass the bottom of the nest more than three or four inches, and the mouth or extremity, is always left in an apparently unfinished state. The baya lays from

four to six white eggs (5 natural size). For what reason I know not, many nests are always left unfinished, as in 3 and 4. Bayas seem to be of a very social disposition; numbers build on the same tree, or on neighbouring trees, and sing in concert during the breeding season, with a very pleasing effect, though there is no variety in their notes. The nests do not seem to be entirely deserted by the old birds at any part of the year; the young ones probably separate from them, and form new colonies, as, at certain seasons, they are to be seen by themselves in large flocks.

The following passage is quoted, in the *Architecture of Birds*, as an "account from a gentleman long resident in India:"—"As to the separate chambers, also, it may be observed, that the fact of their existence is indisputable; and I think it is equally certain that they are not occasioned by adding new nests to old ones, as such additions would at once be discernible, from the difference occasioned in colour and texture by exposure to the inclemencies of the weather." p. 252. This account I cannot reconcile with my own experience, and must suppose that the nests there noticed are not those of the Loxia philippina, but of some other Loxia. The following is a description of the bird which builds the nest I have sketched and described:—Length 5¾ in., breadth 9 in. Bill dusky olive, under part of the lower mandible greenish yellow, nearly six tenths of an inch long, and four tenths in depth at the base, bulky and strong, nearly conical both mandibles of the same size, and having their edges much bent inwards. Eyes small, irides yellow. Lores, cheeks, and throat dark brown the rest of the head bright yellow. Feathers of the neck and shoulders yellow tinged with olive (of the sides of the neck tinged with reddish,) with a dark brown dash down the middle of each. Wings dark brown, the quills having narrow, the prime coverts broad, and the secondary coverts heart-shaped, yellow edges. The lower part of the throat and the breast are bright yellow, passing into very pale dull reddish on the belly and tibiæ. The rump and vent are dull light reddish mixed with dashes of brown. Tail brown, rounded, about 1¼ in. long; the closed wing passes its base a little. Feet and claws pale brownish; the latter long, rather slender, and much bent. The third and fourth quills are equal and longest.

The specimen described was a male in full plumage; but scarcely any two are exactly alike; most of them are plainer and duller in their colours, and many of the females and young birds have little or no yellow on the head or breast.

The baya is very docile, easily tamed, and taught to fly off the finger and return again at a signal; to dart after a ring or small coin dropped into a deep well, and catch it before it reaches the water; to fetch and carry; and to perform other similar tricks. *

* Magazine of Natural History.

COMPARATIVE TEMPERATURE OF WHITES AND NEGROES.

In a manuscript memoir on his voyage to Central Africa, presented to the Academy of Sciences by M. Douville, he has mentioned some experiments on the difference which exists between the temperature of these two races, according to age, sex, &c. These experiments, although in some points imperfect, are, in many, highly interesting. The researches were made in Africa. M. Douville ascertained the temperature of a number of persons at 7 o'clock A. M, before they had been exposed to the sun. Some of the results follow:

1. A White, ...	aged 12 years,	= 29¼° Reaumur.
2. A Negro, ...	12 ..	= 31½
3. A White, ...	20 ..	= 29
4. A Negro, ...	20 ..	= 31
5. A White Woman, ..	14 ..	= 29¾
6. A Negress, ...	14 ..	= 32¼

Whence results, that, *cæteris paribus*, the Negro possesses more animal heat than the white. M. Douville considers that there is a relation also between the developement of heat and of the intellect.

As the passions of the Negro cool with age, he loses a great deal of this excessive heat. He grows old very soon, and at thirty is as aged as a European at fifty-five or sixty years. It is rare to meet a Negro older than forty years; but still the old Negro has a higher temperature than the white in his prime of life. It results from the researches of M. Douville, that the temperature of the Negro is, *cæterisparibus*, much superior to that of the white; that the heat of Negresses is greater than that of Negroes up to the fifteenth year of their age, but after that period, less, but still greater than that of whites; that the Negroes diminish in temperature as they grow old; and, finally, that the old Negroes have a still higher temperature than the whites. *

STATURE OF THE HUMAN RACE.

Contrary to what occurs among domestic animals, variations of stature in the human race are included in much narrower limits than individual variations. The size of women is less variable than that of men. They are much smaller than men among people of large stature, while the difference in size between the sexes is very small among people of low stature. The people who are most remarkable for their great height, generally inhabit the southern hemisphere, and, as has long been known, those who are distinguished for lowness of stature, almost all reside in the northern hemisphere. Among the people of the greatest height, some live on the southern part of the American continent, others in various archipelagos of the Southern Ocean; and it may even be remarked that they thus form in the southern

* Jameson's Journal.

hemisphere two series, one continental, the other insular, both irregular and often interrupted, but commencing in each at eight or ten degrees of south latitude, and terminating at about fifty degrees. There exist, however, in the southern hemisphere, people whose height is below the mean, and reciprocally in the northern, those whose height surpasses the mean. Now, in comparing the geographical position of these people with those who are extremely tall or extremely short, we arrive at the result apparently paradoxical, and yet in part of easy explanation, that the short race live almost every where near the tallest nations, and reciprocally, the tallest people near those nations who are the most remarkable for their low stature. The diversity of stature in the human race may be explained (but in part only) by the influence of climate, of dietetic regimen and mode of life. It is at least extremely probable that the size of the race, notwithstanding some local variations, has not sensibly diminished; and this, not only from the concurrence of so many kinds of proofs as are derivable from historical evidence from the earliest known periods, but from considerations of science, in the absence of all monuments, it may be infered that there has been no material change since the origin of mankind.*

ON CATCHING, TAMING, AND KEEPING NIGHTINGALES.

By M. Wichterich, of Bonn.†

I HAVE been informed, that, in England, the greater number of Nightingales confined in cages die within a short time after they are caught, and rarely outlive the succeeding winter. This is so far from being the case with me, that I should be ashamed to say I had ever lost more Nightingales than of any of the other birds usually kept in cages: though M. Bechstein has also said, in his Natural History of Cage Birds, that all his Nightingales died within no very long time.

When I have a Nightingale newly caught, I put him in a cage of the form usually called a Nightingale's cage, cover it with a *white* handkerchief—because any darker colour would intercept the light—throwing in ten or twelve meal worms, previously pinching them on the head, to prevent their crawling away and about a handful of fresh ants' eggs.‡ If it do not take to the ants' eggs at first, it will be sure to do so after a few trials, by throwing the meal worms over them. About half a dozen meat worms may be given every three or four hours, for a day or two,

* Revue Encyclopedique.

† Translated from M. Wichterich's manuscript communication to Professor Rennie, by Edward Rennie.

‡ The cocoons (not eggs) of the wood ant (*Formica rufa*), which are sold by measure in Germany, and are plentiful in our own woods.—RENNIE.

till it takes to the eggs; after six or eight weeks it will not be necessary, except for a treat, or as an occasional change of food.

As soon as it takes to feed well, it will begin to sing, which will take place at the longest in about eight days; and it will be important, unless the cage be kept covered with the *white* handkerchief, to let it remain in the same place, as change of place will often make a nightingale leave off singing. Ants' eggs, in the quantity of a handful, or more, daily, for each bird, ought to be the principal food, so long as the nightingale is in song; but when done singing, the composition, called German paste, may be given. It is made in the following manner, of much better quality than what is sold in the shops.

Take four fresh eggs, boiled very hard, a quarter of a pound of white pease meal, and about a table spoonful of good salad oil—if the least rancid, it will not do. The eggs must be grated down very fine, and mixed with the meal, and olive oil. The whole is then pressed through a tin cullender, to form it into grains, like small shot, then placed in a frying pan, set over a gentle fire, and gradually stirred with a broad knife, till it be partially roasted and dried, the test of which will be its fine yellowish brown colour.

All insect-eating birds will soon learn to eat this food, upon which they may be kept all the year; except when they appear drooping and unwell, or at moulting time, when they ought to have a few meal worms twice or thrice a day. While they are in song also, they ought always to have about a dozen or more meal-worms, in the course of every day, with ants' eggs, either fresh or dried. I have had several nightingales, however, which have sung when fed upon the paste alone, without meal-worms.

From the sort of food given by M. Bechstein, I am not at all surprised so many of his birds died when first confined. In order to make a fresh caught bird take to feed, he advises to dip it in water, and after it has shaken and dried itself, it will he says, be rendered hungry, and will readily feed. By my method of giving meal worms and ants' eggs, I never found a single bird refuse to feed, so that the cage be properly covered with a white handkerchief.

The net for catching nightingales which I recommend is made with a semicircular hoop of iron wire, about as thick as a swan's quill, raised upon a cross stick like the common brick-trap. Meal-worms are fixed upon the cross stick with pins or thorns, and when the bird pulls these the stick is deranged and the net falls.

There are two varieties of the nightingale, one which sings both in the night and in the day, and one which sings in the day only. I have found only one that sung in the night out of twenty or thirty caged nightingales. The night singers are considerably larger and darker coloured, that is, not so rusty red as the day

singers, and they are, according to M. Bechstein, more partial to high ground, while the day singers frequent valleys and hollow ways. When it is particularly wished to have a night singing bird, the haunt of one must be discovered about ten o'clock at night, and the bird-catcher must remain by it till day-break, when, if his net is in readiness, he may be sure to take it. I had one night singer last spring, which struck up the fourth evening after he was caught.*

ON THE DISCOVERY OF THE CIRCULATION OF THE FLUIDS IN INSECTS.

By Professor Rennie.

In *Insect Transformations*, published in 1830, I have said respecting certain alleged discoveries of the circulation of the blood, or the fluid similar to blood, in insects, that they "furnish no proof whatever of a general circulatory system, though they appear to indicate local movements;" and in the *Alphabet of Insects* published in 1832, I have said, "there is not, and *cannot be* any real or direct circulation of blood in insects." These are the result of as careful and cautious an investigation of the facts as it was possible for me to make, and my conclusion has not been in the least shaken by anything that has been, so far as I know, subsequently published; for though I have met with an alleged more recent discovery of the circulation in insects, this is decidedly nothing more than a repetition of what has been well known from the time of Lyonnet and Comparetti, and more lately from the works of Straus-Dürckheim, and Dr. Carus of Dresden. The opinion of Lyonnet is well known, and Bonnet has given a luminous abstract of it, and agrees with the author in a note to his Contemplations de la Nature (iii. 19.) Comparetti, who in 1800 investigated the subject with great minuteness in the grubs of Ephemeræ, and numerous other insects says, "the vascular system of the circulation begins from the pulsating dorsal trunk," [*cœur*, Straus; *grande artere*, Lyonnet] "and proceeds by very minute branches through every external and internal part, of the abdomen, of the corselet, of the head, and of the members, flowing back to the greater non-pulsating trunks." He concludes that "the manner in which the fluid of the insect is conveyed to the pulsating organ, with the various properties of the vascular system, remain to be demonstrated."†

* Field Naturalists' Magazine.

† I subjoin the original Italian of the passages which I have here translated.

"Il sistema vascolare della circolazione, comincia dal tronco dorsale pulsante, e progredisce pe' rami li più fini per ogni parte esterna, ed interna, dell' addome, del torace, del capo, e de' membri, ricorrendo a' tronchi maggiore non pulsanti." "Resterrebe dimostrato il modo, con cui il liquido dell' insetto si porti all' organo sante colla diversa qualità del

Even before this, however, the illustrious discoverer of the circulation of the blood, says that "in bees, flies, and wasps, the heart could be distinguished by means of a magnifying glass;"* and M. Lesser also expressly says, "the fluids circulate in insects, and the arteries have a sort of pulsation, which consequently indicates a heart, or something similar."† Baker again speaks of the current of blood being remarkably visible in the legs of some small bugs, and he observed a green fluid passing through the vessels of the wings of grasshoppers.

The late Baron Cuvier, after trying all the usual modes of injecting the great dorsal vessel of insects, as Lyonnet had previously done,‡ could not discover the slightest trace of outlet or inlet thereto, than which nothing could be more decisive against a direct circulation: and M. Marcel de Serres, in 1819, in some experiments not very justifiable, succeeded in removing this dorsal vessel, without causing the death of the insect; but if it were a heart circulating blood, it is impossible that the insect could live without it.

In 1824, Dr. Carus of Dresden published an essay in which he lays claim to the discovery of a circulating system in insects, particularly in the grub of the common day fly (*Ephemera vulgata*), at the same time confessing (and this is an important point) that the circulation ceases in the adult insects, a circumstance for which he endeavours to account on a similar principle to the obliteration of the blood vessels in the bones and feathers of adult birds. Dr. Carus, however, is clearly of opinion that "the insect blood in its currents is not confined to vessels," like the blood of larger animals.§

In 1826, Messrs. Kirby and Spence, after examining the opinions of previous authors, with the exception of Lesser, Comparetti, and Bonnet, conclude very justly, as I still think, that "there is clearly no circulation." But one of these authors, Mr. Spence, writing from Dresden, 28th of August, 1829, admits the discovery of Carus. "The first insect," he says, "to which Dr. Carus directed my attention was the larva of *Ephemera vulgata* (or an allied species) in which near to the branchiæ, and parallel with each side of the body, was very distinctly visible a constant current towards the tail, of oblong globules swimming in a transparent fluid, propelled with a regular pulsating motion; and on cutting the body of the larva across near the tail, three globules were most plainly seen pushed out of the divided vessels in a distinct mass, which increased at each pulsation. I

sistema vascolare."—COMPARETTI, *Dinamica Animale*, 8vo, Padova, 1800, part i. pp. 230 and 236.

* Harvieus, de Motu Cordis, c. 17.

† Theologie des Insectes, ii. p. 91, 8vo, à la Haye, 1742.

‡ Anatomie de Chenille, p. 427.

§ Carus, Entdeckung eines einfachen vom Herzen aus beschleunigter Blutkreislaufes in den Larven netzfluglicher Insecten. 4to, Leipzig, 1824.

cannot express the pleasure which it gave me to see thus clearly this ocular demonstration of one of the most important physiological discoveries of modern times."

These are almost the very terms used in the Examiner newspaper, 14th April, 1833, respecting another alleged discovery of the circulation in insects, claimed for James Bowerbank, Esq. F. G. and Z. S. but who has not, so far as I am aware, made any such claim himself. The details of this *newest* discovery, however, amount to no more than those of Comparetti in 1800, of Carus in 1824, and of Straus-Dürckheim in 1829, and relate chiefly to the grub of an Ephemera, as do those of Comparetti and Carus. It is particularly worth remarking that Mr. Bowerbank expressly says that "the blood does not appear to be confined within any specific vessels," before it passes into the dorsal vessel: which is unquestionably correct, as most naturalists have expressed the same opinion, from Lyonnet downwards; but it at the same time proves that there cannot be any direct circulation.

It may be worth quoting from Goring and Pritchard's Natural History of Living Objects, published February, 1829, a passage respecting the circulation in the grub in question, particularly as it certainly contains a discovery, though this has not, I believe, been claimed as such.

"During the infant state," it is remarked, "of this larva's existence it is very transparent, exhibiting, under the microscope, in a most surprising manner, the circulation of the blood along the large arteries in the body, legs, and tail. While traversing the tail, the blood resembles a string of globules. The part which exhibits the most rapid circulation is the lower lip. The passage of the blood through the head has a very singular appearance. It runs through a vessel which passes quite round the body of the larva, constituting a band, which, incurvating itself on the head, forms, as it were, a semicircular chain round the base of each antenna."

The celebrated Goethe has well remarked, that "the number of real discoveries is small, especially when one views them consecutively through a few centuries; yet people are very busy in repeating what has been discovered by others." Viewing the alleged discovery above refered to, under this point of view, I think I am fairly entitled to repeat from INSECT TRANSFORMATIONS, p. 403, that it "does not advance a step in demonstrating a circulation in insects similar to that of other classes of animals."

I have given details at length from M. Straus-Dürckheim, in the ALPHABET OF INSECTS, with the figure of the heart of a cockchafer, together with the opinions of two of the most distinguished German physiologists, Meckel and Herold, showing that they were all well acquainted with what is now claimed as a discovery.*

* Field Naturalists' Magazine.

THE MAY-FLY.

By a Correspondent of the Field Naturalist's Magazine.

A VERY mistaken notion is prevalent in most places with regard to the insect so well known to fishermen by the name of the may-fly; and until very lately I also acquiesced in the popular error.

Most people, I believe, imagine that the cadis, which is to be found at the bottom and sides of every streamlet, is the may-fly in an imperfect and undeveloped state, and many fly-fishers, as well as other persons, are not aware of the incorrectness of the supposition. The grub from which the may-fly is formed, is to be found under the weeds which grow at the bottom of rivers, buried in a fine green sand, and presenting in every respect an accurate resemblance both in the head and tail to the perfect fly; the growth of the wings being indicated by small pointed substances like the wing-cases on the back of an earwig.

The cadis, on the contrary, when drawn from its covering, does not present either in its head or tail any similarity to the body of the may-fly, nor is there the slightest appearance of the growth of wings; and this is the case not only in February, March, or April, but even after the may-fly has been some time on the water; neither is one cadis ever found in a greater state of forwardness than another, excepting as far as regards its size, which would not be the case if the fly was formed from that grub.

Besides which, numbers of cadis are frequently found in places where *it is notorious that the may-fly never rises at all;* and that simple fact I should consider as a conclusive argument.

DOUBLE VISION WITH ONE EYE.

M. PREVOST, the distinguished professor of Geneva and Mr. Babbage, are annoyed with this irregularity of vision. Whenever they look at an object, without straining their eyes, they see two images, one situated above the other. In the case of the latter philosopher, the upper image is more faint and indistinct than the lower, or true one, and they are separated by an angle of twelve degrees. When his health is deranged, the upper or false image becomes more distinct, but the angle of separation is not changed. In consequence of the smallness of this angle, the image is not ordinarily seen quite double, but there is rather a confused border perceived round the real object; when he looks through any small aperture, the feeble image disappears, and the same effect is produced by inclining the head backwards, and directing the sight somewhat under the eyelid; also by contracting the eyebrows, or by using a concave lens.

The affected eye of M. Prevost sometimes sees three images of the same object, one above the other. He readily ascertained that the highest image corresponded with the most inferior pic-

ture on the retina, by moving slowly a screen before his eye, from above downwards; he thus observed that the inferior image disappeared before the other, and, as it faded, the upper one became more distinct. Sometimes he could hide the images by the eyelids, the upper image by the lower lid, and the lower image by the upper lid. M. Prevost was at first much annoyed by this double vision, for when he was reading, the "o" always seeming "8," &c. By using a convex lens, he found that, by using it at a certain distance from the eye, only one image was seen, but it was surrounded with a light shade; when the glass was withdrawn further, the two images returned, and the same took place when it was brought very near to the eye; but, in the latter case, the images were seen side by side, and not the one above the other. M. Prevost is of opinion, that, in such cases of double vision as his own and that of Mr. Babbage, the crystalline lens is chiefly at fault, so that it becomes a double refractor; this condition may be induced by a fracture, bruise, a partial flattening of its surface, or by a separation of one of its layers. The effect of a fracture is readily witnessed in a glass lens; for, if broken, we at once perceive two images. Dr. Wollaston attributed to this cause his own defect of vision, and found that the error was for the time corrected, by looking through the refracting angle of a prism steadily at the object. It is not necessary that the lens be actually broken: one of its segments or laminæ may be somewhat diplaced and irregularly inclined, and thereby the double refraction may be caused. In the memoirs of Dr. Holyoke, who died at the age of 100 at New Jersey, in 1829, it is stated, that, for several years, all objects were quadrupled or quintupled; when he looked, for example, at the moon, he saw five moons.*

VOMITING IN RUMINANT ANIMALS.

M. Flourens lately read to the French Academy a paper entitled, "Experiments regarding the action of Tartar Emetic on Ruminant Animals." In a preceding memoir the author established, by means of numerous experiments, that the vomiting proper to ruminant animals differs essentially from the vomiting of other animals in this, that instead of being, as the latter, a confused rejection in a mass, it constitutes, on the contrary, a rejection which is affected only in regulated and detached portions. The new paper of M. Flourens is intended to show, that these two sorts of vomiting depend on different stomachs; and thence to arrive at the explanation of this extraordinary fact, that animals which regurgitate with most facility, do not vomit unless with extreme difficulty, or even do not vomit at all. After having instanced the experiments of Daubenton, Gilbert, and Huzard, he details his own. We cannot dwell on them here. We shall

* Medico-Chirurgical Review.

confine ourselves to repeating the conclusions which he has drawn from them. From the facts and observations contained in his paper, the author concludes, 1st. That tartar emetic produces on sheep the same general effect, that is, the same excitation of all the powers which provoke or determine the vomiting which it produces in ordinary animals; 2nd, That among the different stomachs of ruminating animals, it is on the rennet bag, to say on that alone, which, by its functions, as by its structure, corresponds with the simple stomach of other animals, that the emetic displays its action; 3rd, That it is to the particular, and altogether opposite, disposition of this stomach, in reference to those for regurgitation, that is to be ascribed on one hand the facility which ruminant animals have of regurgitating, that is to say, by the throwing up into the mouth the substances contained in the first two stomachs, and, on the other hand, the difficulty which they have in vomiting, *i. e.* in rejecting and bringing back into the mouth the substance contained in the fourth stomach. If it be recollected, that this fourth stomach is that where the definite conversion of the aliment into chyme takes place, that which contains the ruminated substances, the substances which consequently must no longer return to the mouth, whilst the first two stomachs, on the contrary, are those where the aliment undergoes only a certain preparation, those which contain only the substances not ruminated, the substances which consequently must return into the mouth, we shall soon see why every thing must be disposed to render easy the rejection of the two first stomachs, and that of the fourth very difficult. Without this arrangement in fact, the ruminated substances contained in the fourth stomach would be constantly mixed together, confounded and brought back into the mouth, with the substances not ruminated, a confusion which must be an obstacle to the accomplishment of the end which nature proposed to herself to attain by the act of rumination.*

PRESENCE OF ENTOZOA IN THE EYES OF ANIMALS.

Hitherto worms have been seldom, and in small numbers, found in the eyes of animals. M. Nordman has, however, met with them in all the eyes of fishes, reptiles, and birds. In the summer of 1829, he met with an immense number in most fishes. It is particularly in the vitreous humour, near the companula Halleri, and even in the crystalline lens, that he has observed them in groups of from 60 to 100 individuals. They are generally of a new genus of the Nematodes; he has also met with two new distomas, contained, as he says, in hydatis; and finally, very rarely a species of capularis.†

* Dublin Journ. of Med. and Chem. Science. † Ibid.

NEST OF THE GOLDEN-BANDED ORIOLE.

THE cut represents the nest of the golden-banded oriole, one of a well-known brilliant family of tropical birds. Its natural song, though varied and well modulated, is said to be improved when the bird is caged, by its mingling with its wild wood notes the melody of regular compositions.

The hammock is of twisted fibrous substances, and so placed as to swing to the breeze. The loops by which it was strung up are very inartificially made, and it does not otherwise exhibit much nice labour in its construction; nevertheless, the simplicity of its materials renders it curious. The twine-like fibres of which it is woven, are the filaments taken from between the folds of the gigantic fan palm (*corypha umbracula*). These threads break away from the leaf in the process of expansion, and hang like fringes to the magnificent foliage. The nest was situated, just as the drawing represents it, between the crutches of a low thorny, small leafed shrub, in an open savannah.*

ON THE FORMATION OF PEARLS.

DR. BAER, of Koenigsberg, rejects the old hypothesis, lately revived by Sir Everard Home, which represents pearls as originating in abortive ova. The following are the results of Dr. Baer's investigations. 1. In the fresh water mussels of Germany, though true pearls are rare, yet in most of the species which he

* Field Naturalists' Magazine.

has examined, he has occasionally succeeded in discovering them. 2. He has never met with them either in the ovaries, liver, kidney, or any of the internal organs. 3. The pearls were always situated either in or under the skin of the back, where it is close to the shell. 4. In the same part of the integuments, small coagulated isolated masses are often observable, exhibiting, however, no traces of organization. He conceives, that the pearls are the result of an ulterior formative process taking place in these isolated amorphous masses, and, although comparatively few of them eventually undergo this transformation, cannot be fairly urged as any objection to the truth of his hypothesis. He suggests, that those only may ultimately become enveloped with a layer of calcareous matter, which are nearest to the *external surface* of the integuments, the natural organization of which adapts it for such a secretion. This view of their formation is still farther supported by the fact of pearls having been found by other naturalists, not merely in the above described situation, but also in free or unattached portions of the integuments, or in mantle flaps. The observations of Reaumur in the Memoirs of the Academy of Paris, (1717), as well as those of L. D. Herman, who spent many years in the investigation of this subject, tend to corroborate the opinion of Dr. Baer. Even the drawing given by Home vouches for the correctness of the German physiologist, as the pearls in it are evidently placed in the integuments, namely, in that part of them which is opposite to the heart, and to which the ovary never extends. It is probable that, in some instances, the little soft masses already alluded to became coated externally with calcareous matter, thus accounting for the cavity observable in many pearls; whilst in others, on the contrary, they become infiltrated and saturated with the same material, and thus form solid pearls. That pearls are merely morbid concretions may, indeed, be considered as long since satisfactorily made out; the peculiar merit of Professor Baer consists in directing attention to the soft coagulum which precedes their formation. The thicker the layer of mother-of-pearl on the inner surface of the shell, the more capable, he conceives, is the individual of converting these coagula into pearls. There is, he admits, another variety, originating in the presence of foreign bodies, such as grains of sand, &c. between the shell and the integuments, which become enveloped in a layer of pearly matter; and a third species, as is well known, may be generated by boring into the shell, or, indeed, originates sometimes without any external injury, merely in a diseased secretion of the mantle.*

* Dublin Medical Report.

MACKEREL BURYING THEMSELVES IN THE MUD.

Admiral Pleville-Lepley, who had his home on the ocean for half a century, assured M. Lacepede that at Greenland, in the smaller bays surrounded with rock, so common on this coast, where the water is always calm, and the bottom generally soft mud and fuci, he had seen in the beginning of spring myriads of mackerel with their heads sunk some inches in the mud, their tails elevated vertically above its level; and that this mass of fish was such, that at a distance it might be taken for a reef of rocks. The Admiral supposed that the mackerel had passed the winter torpid under the ice and snow; and added, that for fifteen or twenty days after their revival, these fishes were affected with a kind of blindness, and that then many were taken with the net; but as they recovered their sight, the net would not answer, and hooks and lines were used.*

SERPENTS.

M. Duvernoy, who has devoted much time to the study of the organization of venomous serpents, has ascertained that, besides the venomous teeth in front, the existence of which has long been known, they have in the hinder part of the jaw longer and stronger teeth, of as great malignity. He is also inclined to think, that the secretions of the lachrymal glands in some descriptions of venomous serpents, do not go to moisten the eye-balls, but enter the mouth, and assist in communicating saliva to the food.†

ON THE REPRODUCTION OF NERVES.

By Tiedemann.

It is a well known fact, that nerves, after having been cut through, have the power of uniting and growing together again. The phenomena observed in this process are the following :—In the first place, the ends of the divided nerve recede from each other, so as to leave an interval of from about two to six lines, or more, between them. This is more striking in great than in small nerves. It does not depend on their elasticity, as some have imagined, but on the organic contractibility of tonicity of the neurilema, and of the surrounding and connecting cellular tissue. The proof of this is, that the same phenomenon does not occur in the dead body on dividing the nerve. In consequence of the irritation produced by the division, inflammation soon sets in, and the nerves assume a red colour, and become thickened, generally for the space of from half an inch to an inch, from the point of section. These appearances are the more remarkable in the end connected with the nervous system, than in the other. Coagulable lymph becomes deposited around them, and minute vessels appear in it. In consequence of the inflammation and the effusion of lymph into the cellular tissue around the general

* Jameson's Journal. † Horticultural Register.

sheath and between the partial sheaths, a swelling or knot is produced of the ends of the nerves, that on the upper end being the largest; similar bulbous swellings are found on the ends of nerves divided by the amputation of a limb. After a few days the separated ends become connected by the effused plastic lymph, which gradually assumes a firmer texture, and shows less blood in its vessels. The bulbs gradually approach each other, and at last unite; and thus the connexion between the parts of the divided nerve is restored. On examining the swelling some time afterwards, it is found to be of a bright or greyish-red colour externally, and white in the centre; and medullary fibres are seen passing through it, and completely connecting the nerves. The knot remains for a long time after the cure has been completed. It has been found 50, 60, 90, 100, 110, and even 185 days after the division of the nerve. The author observed it in dogs two years after; and in the human subject, six or eight years after the amputation of the arm.—It is a question which has given rise to much controversy, whether the substance connecting the divided extremities of the nerves has the true nervous texture, and be capable of conveying sensation to the brain, and volition from it. Arnemann, Michaelis, Meyer, Cruickshank, and Haighton, insist that the nervous substance is really regenerated, and that the nerve becomes capable of again performing its functions. Prevost also made some experiments on cats, which led to the same result; and Swan came to the same conclusion from his experiments on rabbits and dogs. The preceding experiments certainly go to prove, that a true regeneration of the nervous issue takes place; but none of them are very satisfactory as to the restoration of the powers of sensation and motion to the parts whose nerves had been divided. The author of this paper consequently determined to make some more decisive experiments on the subject; one of the most satisfactory of which was the following. On the 16th August, 1827, he laid bare the axillary plexus of a dog, parted the several nerves, and cut out of each a piece of from ten to twelve lines in length. The animal immediately lost all power of feeling and motion in the corresponding limb. The wound healed in three weeks, the limb continuing in the same paralyzed state, and appearing evidently wasted, in comparison with the other fore leg. When the dog walked or ran, it went on three legs, and raised the fourth by means of the muscles of the shoulder. In May, 1828, that is, eight months after, the author observed that the animal began to use the injured limb again, and that when pinched or pricked with a needle in the paw, it showed some signs of feeling. During that and the following year, the powers of sensation and motion gradually returned, till at last they seemed as perfect as they had been previously. In order to examine the condition of the nerves, the dog was killed on the 2nd June, 1829, twenty-one months after the operation. They were then found to have oval swell-

ings or knots at the points where the pieces had been cut out; those above were larger than those below. Between these swellings, and connecting them, were portions which had been evidently reproduced, and consisted of bundles of white nervous filaments: they were, however, thinner than the rest of the nerve. When laid upon a plate of glass, and moistened with nitric acid, they were not dissolved, which proves that they contained the true nervous substance. This experiment affords a convincing proof that nerves are capable of being regenerated, at least in the lower animals. With respect to the human subject, there are several observations which prove it in an equally convincing manner. Some of these are to be found in Swan, &c. Again, several cases have been recorded in medical periodicals, in which portions of a finger that had been chopped off by accident, and united again, gradually recovering the power of feeling and motion after the healing of the wound. Lastly, the well known fact that those who have had a nerve divided, or even a piece taken out in cases of neuralgia, are often attacked again by their old tormentor after some time, can only be explained by supposing the reunion and regeneration of the nervous tissue. A remarkable case of this description is to be found in Abernethy's surgical works.*

ON THE NATURAL HISTORY OF THE SALMON.

By Dr. Knox.

The object of the author was a careful examination of facts in the natural history of the salmon, which hitherto have been taken merely upon opinion. He watched and carefully observed personally the deposition of the ova or eggs of the salmon under the gravel,—its long confinement in that situation,—its growth into a fish of about an inch in length,—its ascent through the gravel, and rapid growth whilst in the rivers: the journals of observation were partly read to the Society. Twenty weeks was the period from the time of deposition to their bursting the outer shell; for nine days longer they continued under the gravel as fishes, drawing their nourishment from the yolk of the egg, which is of course attached to them by the umbilical vessels, or, more properly, by the ompholo-mesenteric vessels. During this period, they do not eat or grow much, but without doubt acquire strength. When the yolk on which they have been feeding becomes nearly exhausted, they rise from their sandy and gravelly bed, making their way to the surface, through a thickness varying from one to two feet, and at last gain their new habitat in the waters. In ten days they may be caught in the rivers, very considerably grown, and in twenty days have attained a length varying from six to nine inches.

An extensive personal inquiry showed that they are never the

* Dublin Medical Journal.

prey of trout; and a more limited one renders it doubtful if they *ever* become the prey of kelt, or spawned salmon, on its return to the ocean. It is probably to avoid the effects of severe frosts, that the salmon selects the bed of the running stream as the spot for the favourable deposition of the ova. The beds of rivers, he conjectures, must vary somewhat in temperature; and the author supposes, that extreme frosts are less likely to reach the gravel under the stream than under the pool. Frequent experiment has convinced the author, that the opinions of Sir Humphry Davy, Jacobi, and others,—opinions which maintain that the gravel below the stream is selected by the salmon, on the ground of the better aëration of the ova, have no real foundation whatever.

The food of the fry has been determined precisely, and their whole habits, by repeated anatomical examinations made by himself.

The salmon seems to hybernate somewhat in certain seasons; a great number of salmon and trout do not enter into the spawning condition, and consequently may be got in first rate order as food, at any time, provided they have the means of subsistence: now, this the salmon can always get at in the ocean, which is his true feeding ground. He cannot get food in rivers of the kind he desires. The salmon-trout, on the contrary, even at the mouths of rivers, will take to the fry of other fishes, to small fishes, and to worms; and in rivers, he will feed on the larvæ of insects, insects themselves, and, in short, on the ordinary food of trout.

The true salmon prefers a peculiar kind of food, the ova of the echinodermata, and takes, with great reluctance, any other. Hence, the moment he enters rivers, having abandoned his natural feeding ground, he deteriorates constantly, refuses all kind of food, loses weight and flavour, and gets, in short, entirely out of order. Nor can he ever recover from this state, till he has revisited the feeding ground in the ocean. It is easy to perceive, in these few statements, how entirely they alter the whole question of the salmon fisheries.

These inquiries led the author to examine into the history of the herling. They resemble in their habits the salmon-trout, haunting the feeding-ground of the salmon; and when fed on the peculiar food of the salmon, their flavour is excellent; but they take readily to coarser food, as small herrings, fry, sand-eels, and the fry of any other fishes. Their stomach and intestines get loaded with putrescent debris, their flesh loses its flavour, and their condition, as articles of human food, has changed materially. No two conditions can be supposed more opposite than the herling presents, when fed on salmon food, and when fed on fishes. They differ, therefore, from salmon-trout in this respect: that, when feeding on the food of the salmon, they attain almost the flavour of the salmon, which the salmon-trout never does.

The author discovered and exhibited the food of the vendace

of Lochmaben, which had never been seen before by any one; explained the reasons why this fish could not be taken with bait; proved the vendace to be male and female, and offers suggestions for the stocking of the various lakes in Britain with this exquisite fish, pointing out first the necessity of locating its natural food, without which it cannot live. The discovery of these circumstances, with regard to the vandace, led the author immediately to think of the herring, whose food and natural history generally he believed to be unknown.

It was ascertained that the herring resembles the vandace in its habits, as to food more particularly; and that whilst feeding on the incredibly minute entomostraceous animals, which it more especially affects, the condition of the herring is excellent, rendering it an extremely desirable food for man. In this state, the stomach seems as if almost altogether empty (as in the vandace), though at the moment full of minute animals, to be discovered only with the microscope, and on which the animal has been feeding. The intestines also seem as if empty; the tunics of the whole digestive canal are fine and semi-transparent, and as free of intestinal and putrescent debris found in the stomach and intestines of animals, as if the herring actually fed on nothing but air and water. When he approaches the shores, thus quitting the proper feeding-ground, he takes to other and coarser food; his condition alters, and his flesh becomes soft and tasteless. The stomach and intestines are found loaded with putrescent remains, and gutted or ungutted, this fish could never be brought into the market as equal to the product of the Dutch fisheries.*

THE NUMERICAL RELATIONS OF ANIMALS.

1. MAMMALIA.

	Year.	*No. of Species.*
Linnæus enumerates,*	1767	221
Humboldt,†	——	500
Desmarest,‡	1822	850
Temminck,‖	1827	860
Lesson,§	1827	1124
Minding,¶	1829	1230
Fischer,**	1830	1126
Bonaparte,††	1831	1138

* Systema Naturæ, edit. 12. Holmiæ, 1767; the last edition superintended by Linnæus.
† Ann. de Chim. et de Phys. xvi.
‡ Mammalogie; Paris, 1820 et 1822. 4to.
‖ Monographies de Mammalogie, vol. ii.; Paris, 1827.
§ Manuel de Mammalogie; Paris, 1827.
¶ Ueber die Geographische Verbreitung der Saugethiere; Berlin, 1820.
** Synopsis Mammalium; Stuttgardt, 1830.
†† Isis, 1832, Heft 3. Linnæus, Humboldt, Temminck, and Minding, enumerate only the living Mammalia, the others also the fossil, of which we know 120 species. Fischer enumerates, besides the 1126 well determined species, also 200 dubious.

If we take into account the discoveries of these few last years, we may reckon in round numbers the living species at 1,100. Lesson enumerates many species which are doubtful; and Temminck mentions those only which have been well determined.

2. BIRDS.

	Year.	*No. of Species.*
Linnæus,	1767	904
Buffon,	——	1700
Lesson,	1830	6500
Bonaparte,	1831	4099

3. AMPHIBIA.

Linnæus,	1767	204
Lacepede,	1802	500
Merrem,*	1820	579
Humboldt,	——	700
Bonaparte,	1831	1500

4. FISHES.

Linnæus,	1767	376
Bonaterre,†	1788	746
Lacepede,	1802	1300
Cuvier,‡	1827	5000
Bonaparte,	1831	7000

5. MOLLUSCA (INCLUDING THE CEPHALOPODA.)

Linnæus,	1767	1832
Lamarck,§	1822	3028
Schmidt,‖	1830	4548

6. ANNELIDES.

Linnæus,	1767	50
Blainville,¶	1827	315

7. CRUSTACEÆ.

Linnæus,	1767	111
Fabricius,**	1793	250

8. ARACHNIDA.

Linnæus,	1767	97
Fabricius,	1793	138

9. INSECTS.

Linnæu	1767	2616
Fabricius	1800 to 1805	12,513

According to the different Orders, the numbers are as follow:

	Fabricius.	*Linnæus.*
Coleoptera,	4330	903
Diptera,	1224	262
Hymenoptera,	2101	314

* Systema Amphibiorum.

† Encyclopedie, 4to.

‡ Histoire Naturelle des Poissons.

§ Animaux sans Vertebres.

‖ The number in Schmidt's collection at Gotha.

¶ Dictionnaire des Sciences Naturelles, tom. xlvii. vers.: the Leech, which he separates, and of which he enumerates 39 species, is here included.

** The number of Crustacea, Arachnida, and Lepidoptera, are from Fabricius, Entomologia Systematica, 1793 and 1794; the other orders of Insects are according to his Systema Antliatorum, Rhyngotorum, &c. Humboldt enumerates 44,000 species of Insects; Sachs in the Berlin Zeitung 50,000 Insects, 26,000 Arachnida? 1,500 Crustacea.

	Fabricius.	*Linnæus.*
Neuroptera,	170	83
Aptera	123	62
Orthoptera,	235	—
Lepidoptera,	2919	780
Hemiptera,	1384	253
Myriopoda,	27	19

It may not be uninteresting, as regards insects, to compare the progress of the classes and species with the number of genera, between Linnæus in 1767, Fabricius from 1794 to 1805, and Latreille, in the 2nd edition of Cuvier's Regne Animal, in 1829 :

No. of Genera.	*Latreille.*	*Frbricius.*	*Linnæus.*
Crustacea,	209	12	3
Arachnida,	66	11	4
Insecta,	1423	431	—
Coleoptera,	700	181	30
Orthoptera,	36	8	12
Hemiptera,	84	46	
Neuroptera,	27	12	7
Hymenoptera,	207	83	10
Lepidoptera,	87	15	3
Diptera,	258	81	10
Myriopoda,	8	2	2
Thysanura,	4		
Parasita,	9	5	5
Suctoria,	1		
Rhipiptera,	2	..	..

10. ENTHELMINTHA.

	Year.	*No. of Species.*
Linnæus,	1767	15
Zeder,	1803	390
Rudolphi,*	1819	1100

11. RADIARIA OR ECHINODERMATA.

Linnæus,	1769	46
Blainville,†	1830	280

12. MEDUSA.

Linnæus,	1767	11
Eschscholtz,‡	1829	208

13. ZOOPHYTA OR POLYPI.§

Linnæus,	1767	134
Blainville,	1830	536

14. ROTATORIA.

Linnæus,	1767	8
Ehrenberg,‖	1832	291

15. INFUSORA—POLYGASTRICA.

Linnæus,	1767	8
Ehrenburg,	1832	291

* Synopsis Entozoorum ; Berolini, 1819. 8vo. At present, probably the number of known species of Vermes may amount to 1500.

† Dict. des Sciences Naturelles, tom. lx.

‡ Sytem der Acalephen. Berlin.

§ The Actiniæ and Spongiæ are included under this head.

‖ Zur Erkentniss der Organisation im kleinsten raum. Berlin.

The total number of known living species of animals thus appears to be :—

Mammalia,	1,100	Insecta,	50,000
Birds,	6,500	Enthelmintha,	1,500
Amphibia,	1,500	Radiaria,	280
Fishes,	7,000	Medusaria,	208
Mollusca,	5,000?	Polypi or Zoophyta,	536
Annelides,	315?	Rotatoria,	119
Crustacea,	1,500	Infusoria,	291
Arachnida,	3,000?		
		Total Number,	78,849.

The number of Fossil animals may be stated as under :

Mammalia,	120	Crustacea,	100
Birds,	25	Insecta,	150
Amphibia,	50	Radiaria, Annelides,	350
Fishes,	250	Zoophyta,	500
Mollusca,	3,100		
		Total,	4,645

In order to compare the numerical relations of the animals of single lands, we shall place together the Fauna of Greenland, that of Wurtemberg, and that of the vicinity of Nice, or of the Maritime Alps. The animals of the Fauna of Greenland are according to Fabricius's *Fauna Gronlandica*, Hafniæ, 1780 ; the Wurtemberg animals are from a small work entitled, "*Uber Wurtemburgs Fauna*," Stuttgard, 1830 ; the animals of the Nice district are from Risso's *Histoire Naturelle des principales Productions du Midi de l'Europe*, Paris, 1827. These three may be considered as the representatives of the middle and southern parts of Europe ; and although Greenland does not belong to Europe, it may be considered as a general representative of the polar Fauna :

	Greenland. Lat. 60°—70° N.	Wertemberg. Lat. 47° 30'—49° 30' N.	Nice. Lat. 43° N.
Mammalia,	31	41	59
Birds,	54	213	306
Amphibia,	1	18	40
Fishes,	44	47	400
Crustacea,	38		200
Arachnida,	15	(with Lernæa,) 4000	100
Insecta,	64		1600
Mollusca,	61	100	1085
Annelides,	62	13	82
Enthelmintha,	25	48	70
Radiaria,	14	..	100
Zoophyta,	58	11	200
Infusoria,	..	12	..
	467	4503	4242

It may here be observed, that the Infusoria and Enthelmintha are but slightly noticed: there may be in Wurtemberg 300 or

upwards of Infusoria, and even more of Enthelmintha; the marine and other Infusoria of Greenland and Nice are not mentioned; and it is evident that the number of insects is too small for the maritime Alps.

Even more interesting than the numerical relations are those connnected with colour; which, however, can only be studied with effect in great collections, and with the assistance of good coloured drawings and engravings. On this subject, we have the following, among other questions, to answer. How are the colours related in the animal kingdom in general, and also in the separate classes, orders and genera? Do we find particular colours predominating in certain genera, orders, &c. or are they peculiar to them? What are the relations of the dorsal and abdominal colours, and latero-dorsal and latero-abdominal colours? What influence has light? How are the colours related in warm and cold countries? How are the colours in the animal kingdom disposed, according to latitude and longitude, and height above the level of the sea? Has the sea, and fresh-water lakes, &c. determinate influences on differences of colour? Investigations of this kind belong to general natural history, and the characteristic of the animal kingdom. Unfortunately these general physiognomical relations in zoology have hitherto been much neglected. Botanists are further advanced in their representations in the delineation of the physiognomy of plants. It is exceedingly to be regreted, that with the exception of some partly antiquated, partly unsatisfactory, or, when good, illustrative only of particular classes, treatises on the geographical distribution of animals, such as those of Zimmerman, Latreille, Prichard, Ferusac, Minding, we have no general classical work on this beautiful branch of zoology.—*Professor Rudolph Wagner, Erlagen.**

THE WATER SPIDER.

The habitation of this insect (*Arenea aquatica*) is chiefly remarkable for the element in which it is constructed, and the materials that compose it, being built in the midst of water and in fact of air, a very uncomfortable one certainly, were it constantly wet; but this, the sagacious insect has the means of avoiding, and by availing itself of some well known philosophical principles, constructs for itself an apartment in which it resides in comfort and security. The following is the process: First, It spins loose threads in various directions to the leaves of water-plants, which may be called the frame-work of the chamber, and over them spreads a transparent varnish, resembling liquid glass, which issues from the middle of its spinners, and which is so elastic as to be capable of great expansion and contraction. The spider then spreads over its belly a little of the same material, and ascends to the surface. The precise mode in which a bubble of

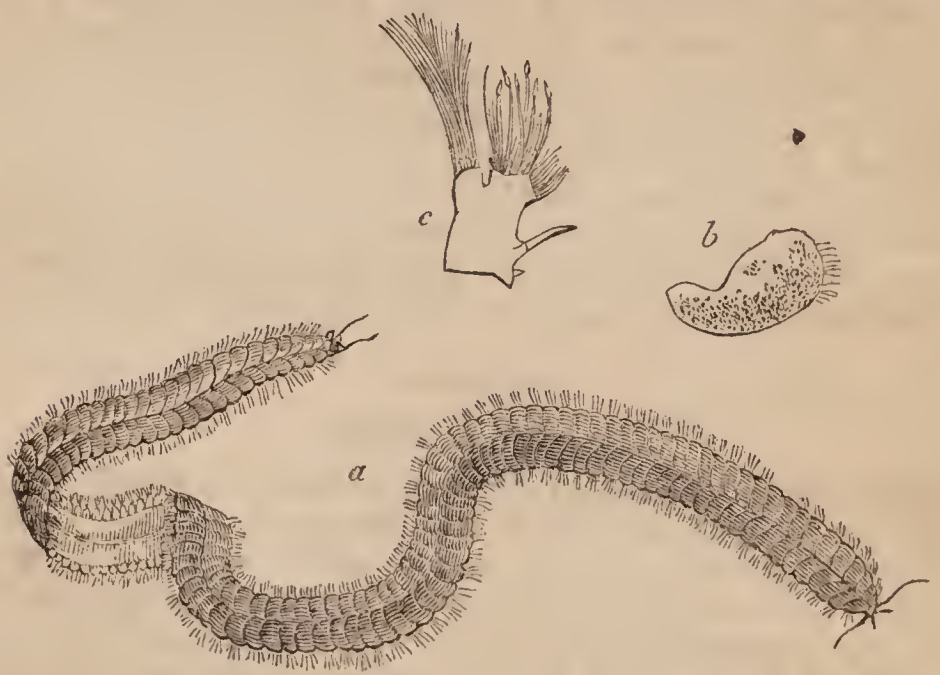
* Translated in Jameson's Journal.

air is drawn in beneath the gummy matter is not accurately known; loaded, however, with the material for its little mansion, which, to the spectator, looks like shining quicksilver, the spider plunges to the bottom, and, with as much dexterity as a chemist transfers gas into a gasholder, introduces the bubble of air beneath the roof prepared for its reception. This manœuvre is repeated ten or twelve times, until, at length, in about a quarter of an hour, as much air is obtained as is sufficient to expand the apartment to its proposed extent, and the industrious little builder now finds itself in possession of a perfect air built dwelling, affording a commodious and dry retreat in the very midst of water. Here the inhabitant reposes, unmoved by the storms that agitate the surface of the pool, and devours its prey at ease and in safety.*

ON THE SIGALION BOA.

By Dr. George Johnston.

I OFFER, for the first time, to British naturalists, a native representative of Sigalion, a genus of annulose worms established by M.M. Audouin and Milne Edwards, for such species of the aphro-



dite family as have a greatly elongated body, and cirrhi to all the feet. One species is indicated by Cuvier in the *Regne Animal*, vol. iii. p. 207.; but, as the name only is given, I cannot say in what respects it agrees or differs with the one now figured.

The body is long, linear, flattened, slightly tapered towards the tail, the anterior extremity obtuse and somewhat rounded. Back covered with two rows of close scales of an ash colour; but, as some of the scales are often paler or whitish; the body then appears piebald. Mouth inferior, furnished with a retractile

* Quarterly Journal of Agriculture.

proboscis, about an inch long, cartilaginous, cylindrical, marked with a pale line along each side, and some fine transverse lines, armed near the apex with four triangular, acute, horny teeth, placed round at equal distances; and exterior to these there is a series of corneous serrated plates, which form, in fact, a circular saw at the entrance. Palpi two, setaceous, simple, half an inch long, arising above and at the sides of the mouth. Head minute, concealed by the rounded anterior pair of scales, without eyes, terminated in front with three short setaceous two-jointed tentacula, the central one larger and longer than the others. Scales over lapping, kidney-shaped, convex, roughish, cinereous; the concealed portion white, the outer and larger margin fringed with very delicate hairs and some short anomalous processes: there are probably not less than two hundred scales on each side, and they are affixed each to a fleshy process, from the outer end of which a tentacular filament is extruded, equal to the feet in number, and placed exactly above them. Feet extremely numerous, fleshy, cylindrical, obtuse, bifid; the upper branch terminated with a brush of long unequal hairs, and the under furnished with two rows of shorter bristles. Base of the foot armed with a spinous fleshy process, and with a small tubercle. Between the branches of the feet there are some processes like those on the edges of the scales. The hairs of the upper branch are setaceous, roughish, multiarticulate, non-retractile; those of the under are in part retractile, and have a curious claw-like joint at the end; in some short, in others long and sharply pointed. Tail terminated with two short filaments. Ventral surface pale, perlaceous, marked down the middle with a red vessel. Length, when at rest, 7 in. or 8 in.; when extended, not less than 10 in. or 12 inches.

Sigalion Boa lives under stones, at low-water mark; and, in some parts of Berwick Bay, is found abundantly. When placed in a basin of sea-water, it appears sluggish; but it burrows in loose sand with much rapidity, being enabled to do so by the play of its innumerable feet. I much wonder what can be the use of the jointed claw-like bristles of these organs; even a probable conjecture does not occur to me. The worm is the Goliath of its race, and, I fear, the tyrant also; for its unprepossessing appearance seems to indicate a cruelty of disposition which the dreadful structure of its mouth confirms; so that I doubt not that, like the giants of our early story-books, he delights in blood, and makes his prey of every unwary worm that enters the same furrow or shelters under the same stone.

Young individuals are generally of a light grey colour. I have described the cranial tentacula as being three in number, but I am not certain that the description is very accurate; sometimes I can see one only, and sometimes I think I can see more.*

* Magazine of Natural History.

OCCURRENCE OF SQUILLA DESMARESTII ON THE BRITISH SHORES.

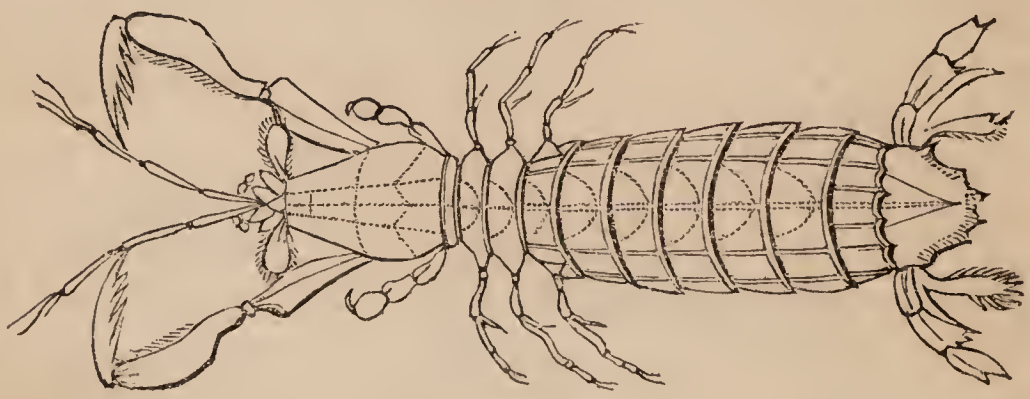
By William Yarrel, Esq., F. L. S.

When Dr. Leach commenced his work, *Malacostraca Podophthalmata Britanniæ,* or descriptions of those British species of the Linnæan genus Cancer which have their eyes elevated on footstalks, he felt assured that many new species would be discovered during its progress, and therefore requested that the plates and descriptions might be so numbered, but not paged, as to admit the interposition of any new subjects that might occur, without interfering with the systematic arrangement intended to be pursued.

Several genera remain yet to be figured, to complete this work, some of which contain species not at that time known to belong to this country ; and were not therefore included in the original manuscript.

I am indebted to the kindness of Mr. Couch, of Polperro, Cornwall, for the possession of a specimen, and also for permission to send a notice of the capture of two examples of Desmarest's Squilla on the Cornish coast, where they were found among seaweed.

This species, which is not uncommon in the Mediterranean, was named and described by M. Risso, in his *Histoire Naturelle des principales Productions de l'Europe Meridionale ; et particulierement de celles des Environs de Nice, et des Alpes Maritimes.*



Stomapodia.

Squilla Desmarestii Risso, Desmarest's Squilla.

S. corpore fusco, dorso lævi ; lineis utrinque duabus lateralibus longitudinalibus elevatis ; pollicibus quinque dentatis.

The figure is the exact size of the specimen taken, and measures 2 in. 4 lines in length. The general colour is yellowish brown ; the antennæ rather long, formed of three filaments, supported on an articulated peduncle of three pieces, of which the first is the shortest ; the eyes mottled ; the corslet grooved ; anterior extremities large, armed with five pointed spines disposed in a line ; the abdominal segments furnished, on each side, with two elevated longitudinal ridges above the recurved marginal

edge, which appears like a third ridge, on each side; the last segment but one has four such ridges on each side the centre; the caudal segment is carinated in the middle, the keel ending in a point above the surface, the posterior edge divided by six strong projecting points, three on each side, with denticulated intervening spaces; attached to the under surface of this portion are lateral articulated processes, flattened, oval, and ciliated.

The species of Squilla are remarkable for their form, particularly for the comb-like appearance of the extremities of the first pair of limbs; and, according to M. Risso the present species is subject to some variation in colour. They live principally in deep water; but the females resort to the rocks in March and August, to deposit their ova, which are of a yellow brown colour. The present species, named by M. Risso after M. Desmarest, is more plentiful in the Mediterranean than Squilla Mantis.

Their external covering, though thin, is firm; and their mode of swimming and general progression is similar to that of the lobster. In their nature they are timid, and endeavour to escape whenever they are pursued. Their flesh is said to be very good, and is eaten almost daily.

Of the several fishes lately added to our British catalogue, four are well-known Mediterranean species. The Squilla here noticed is also common to the same sea; and from the last published part of the Linnæan Transactions I make the following extract, which still further illustrates the subject with which I had intended to conclude this notice:—Mr. Dillwyn, F. L. S., exhibited a series of specimens of the Ianthina fragilis of Lamark, the Helix Ianthina, of Linnæus, collected from Oxwich Bay, to the west of Swansea, accompanied by a letter stating that the same shell, which is abundant in the Mediterranean, had been found once before there in some abundance. Mr. Dillwyn considered the recording such facts of importance, as being likely to throw some light on the under-currents of the ocean." (Linn. Trans. vol. xvi. p. 751.) Dr. Grant found specimens of the same shell, with the animals alive, on the coast of Cornwall, in the month of September last.

Considerable additions to the catalogue of British Crustacea have recently been made, several of which have been recorded; but I am not aware that any notice of the occurrence of a species of true Squilla has been published hitherto.*

THE HARE OF IRELAND.

At the meeting of the Linnæan Society, held March 5, Lord Stanley, the president, sent for exhibition a specimen of the hare of Ireland, which, by comparison with an English hare, also placed on the table, appeared to be very different, although

* Magazine of Natural History.

hitherto unnoticed by zoologists as distinct. The ears, by measure, are full an inch shorter than those of the common hare, and the markings and general colour, as well as the quality of the fur, are decidedly different.*

ON DISSECTING AND PREPARING ANIMALS FOR COLLECTIONS.

By Professor Carus, of Dresden.†

THOUGH the art of anatomizing the bodies of animals is essentially the same as that practised upon the body of man, and though want of space precludes me from treating the subject minutely, I conceive that a few remarks may not be altogether unacceptable to those who feel desirous of pursuing such studies for themselves.

The first thing that I have to observe is, that all dissections of small and soft objects, such as worms, zoophytes, insects, mollusca, and embryos, where it is desirable to obtain even tolerably accurate results, should be performed *under water*, by which the parts are kept floating and separated from each other, and consequently present themselves more distinctly.

A very simple contrivance for investigations of this kind may be prepared in the following manner:—A mass of tough wax (not too soft) is to be laid upon one, or more, porcelain saucers or capsules of different sizes, which are then to be put in a warm place until the wax melts so as to cover the surface evenly to the depth of a half or a third of an inch. If the object to be examined be laid upon this surface, it may be fixed by needles in any position that is wished, and, when covered with clear water, developed and dissected by means of suitable instruments. Of them the best are very delicate forceps; pointed, well-made, sharp-cutting scissors; and small knives like cataract-needles, some round, others with cutting edges, and fixed in slender wooden handles.‡ For separating parts I have also employed small horn probes and fine brushes; whilst for examining them, a good magnifying glass is frequently indispensable. If it is wished to preserve a preparation thus made, wax, coloured at pleasure as for the purpose of injections, is to be formed into little tablets about one-fourth of an inch thick: one of these is then to be placed upon the saucer or capsule containing the preparation; the latter may then be transfered to it, arranged suitably upon it, fixed there by means of short needles, and both together then placed in alcohol. Nor must I forget to mention, that the examination of very delicate organizations may frequently be conducted with greater facility and accuracy, if the object be previously allowed to remain some time in spirit, and thereby to become harder and contracted. This applies particularly to the

* Magazine of Natural History.

† Translated from the German, by R. T. Gore, Esq. Surgeon, Bath.

‡ These instruments may be had of Mr. Blackwell, Surgeons' Instrument Maker, Bedford Court, Covent Garden.

dissection of nervous organs, and to the examination of very small embryos, of mollusca, and worms.

There are various modes of destroying worms, insects, mollusca, &c., for the purpose of dissecting, without injuring their organization: mollusca, snails, for instance, as Swammerdam has remarked, are to be allowed to die in water, because by that means their body swells, and all the parts become more distinctly visible; they may be afterwards kept in spirit (though not too long) for dissection. Worms, the larger zoophytes, (for the smaller must be examined while alive,), caterpillars, &c., and also the smaller amphibia, and fishes, are best destroyed by means of spirit. Insects, on the contrary, by being dipped rapidly in boiling water, or in oil of turpentine.

As regards the dissection of larger animals, we may here use with advantage knives of a large size; and, instead of forceps, suitable hooks with handles.

In animals of considerable size we can generally make artificial skeletons only after the bones have been sufficiently cleaned by boiling or maceration. In smaller animals, on the contrary, such as birds, amphibia, and fishes, of which last it is very difficult to make good skeletons, the object will be best accomplished by at once making the bones as clean as possible, without injuring the capsular ligaments, soaking the preparation in water, that is incessantly changed; and lastly, bleaching it for some time in the sun. Lastly, we may mention injections as affording a very essential assistance in zootomical investigations for physiological purposes: in small animals, and in the more minute parts, these must consist of compositions with wax, very fluid and coloured; best of all of mercury. The latter, however, is not suitable for very soft bodies, such as medusæ, &c., in which cases we may employ injections of coloured milk, and similar substances.*

ON THE HUMMING OF GNATS.

It appears very probable that the humming noise emitted by the gnat when flying about in a dark room is useful to the insect itself, for, as it would be differently modulated according to its distance from, or nearness to, surrounding objects, it may have the effect of preventing its injuring itself by knocking against obstructions to its flight. As a proof of the great difference in sounds arising from even but trifling causes, we have only to take a card in hand and whistle against its edge at a little distance, then at a greater distance, and then against its flat surface at a greater or less distance, and we shall observe that the tone widely differs under each of these circumstances. Now, if we suppose that the gnat knows, from either instinct or experience, that sounds thus differ according to such circumstances as the

* Field Naturalist's Magazine.

above, it may learn its situation in a dark room by the variation produced upon its piping noise (which may thus be as serviceable to it in the dark as its sight in the day time), and avoid breaking its wings, or otherwise hurting itself by flying against anything in its way. In the same manner, probably, one may explain the utility of the humming of the cockchafer (*Melolontha vulgaris*), the dung-beetle (*Geotrupes stercorarius*), and many other insects.*

ACCOUNT OF AN ALPINE SWIFT, SHOT IN NORFOLK.

By the Rev. Thomas Fulcher.

On the 14th of October, 1831, a bird-stuffer, then living in the adjoining parish, showed me the skin of a species of swift which was shot in this village in the previous month of September, and was warm and bleeding when taken to him. I afterwards directed him to stuff it for me; and the specimen is now in my possession, but not in a very good state. In measuring it, some allowance must be made for the shrivelled state of the skin. The

length, from the tip of the bill to the end of the tail, is rather more than eight inches; breadth across the wings twenty inches; it is much more bulky than the common swift *Cypselus murarius* Temminck,) and must have weighed, at least, as much again. Bill nearly two-fifths of an inch long, measured from the base of the upper mandible, curved and black; the colour of the irides unknown, but I believe it was dusky. The head, back of the neck, back, wings, and tail grey brown, and the edges of the feathers of a paler colour. Round the breast is a collar of grey brown. The throat, lower part of the breast, and the body to the commencement of the under tail-coverts white; the sides dusky, with a mixture of dull white; under surface of the wings and tail, and the under tail-coverts dusky. The quill-feathers are darker than the back, and remarkably strong and pointed; the quills dusky white. The back, wings and tail have copper-coloured and green reflections when viewed in particular lights. The tail is more than three inches long, forked, and consists of

* Field Naturalist's Magazine.

exactly ten feathers. Legs short and strong, flesh coloured, and feathered to the toes, which are all placed forward, as in the common swift; the claws strong and brownish black.

When I first looked at the bird I was puzzled to know what it was; but it soon struck me that it might be the bird referred to by White (Letters 40 and 61) under the name of *Hirundo melba*, or great white-bellied swift of Gibraltar; and on receiving from my friend—before alluded to—the description given by Latham in his Synopsis of that bird, I had no further doubt on the subject. The Quarterly Review, in an article on American Ornithology, mentions a specimen having been shot off the coast of Ireland; but I am not at present aware that naturalists have noticed any other as having been seen in the British Isles. I find no notice of it in Rennie's valuable edition of Montagu. Latham gives the length eight inches and a half, and weight two ounces five drachms. He says the species is not numerous; that it builds in the holes of the rocks in the mountainous parts of Spain, and is found at Gibraltar, and in Savoy, &c.*

THE STRIPED SQUIRREL OF CANADA.—STRIATUS, STRIPED DORMOUSE.—(*Pennant.*)

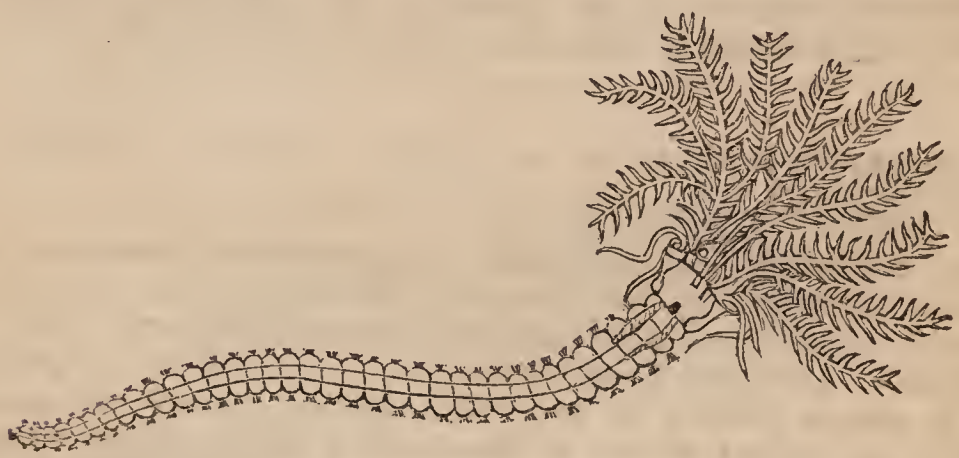
This interesting and elegant little animal seems, in some measure, to form a connecting link between the squirrel and dormouse tribes, having the outward form of the former, with the habits of the latter. It is very common in the neighbourhood of Quebec, but is rather difficult to meet with, on account of its retired habits; its colour above is brownish red, on the under side white: along the ridge of the back, and on each side, runs a black streak, the spaces between each being of a pale yellow colour; its tail is rather longer than the body, and covered with a spreading fur, but less abundantly than in other squirrels. It is plentiful in the crevices of the rocks forming the bank of the St. Lawrence, from the Chedier River to St. Nicholas. It also breeds commonly in the cellars and crevices under some of the Canadian wood houses. A young one of this year, which was captured in a room, soon became very tame, and played about, regardless of the persons to whom it was accustomed; but was always timid before strangers, skulking into a corner of its cage, and burying itself in some dry grass placed there for its bed. It had a very shrill whistling cry, which it repeated at intervals, as it jumped against the wires in front of its cage. It was extremely nimble, and could get through very small crevices, frequently escaping by pressing asunder the wires of its cage, and on these occasions was very difficult to recapture; but if allowed to run about the room for some time, would attempt to enter its cage again of its own accord. It was fed principally upon shelled

* Field Naturalist's Magazine.

almonds and raisins, but was fond of apples, and other pulpy fruits; it also ate grain; and this forms a large portion of its nutriment in the wild state. I regret to say that one day, during the temporary absence of my friend, the squirrel escaped, and, in endeavouring to retake it, the people of the house frightened it out into the fields; and although it several times returned as far as the threshold of the door, yet the ill-judged attempts at re-capturing it at last completely scared it from the spot.*

THE SABELLA AMŒNA.

This is a minute but singularly beautiful worm, which lives in a small tube composed of gravel and sand, reared by and for itself, amid the entangled roots of corallines. When danger threatens, the worm withdraws entirely into its furrow, twisting its feathery ornaments into a cylindrical shape; but when all is



calm without, the anterior portion of the body is thrust cautiously from the tube, and the garniture of the head is displayed so as to form a circle of miniature plumes of great elegance and delicacy.

The animal is scarcely an inch long, with a vermiform body of a reddish or flesh colour, the tint varying in intensity, according to its state of repletion. The head is truncated, and invested with a fine membrane divided in front and produced at the sides into angular points. On the upper and dorsal margin there are two dark, prominent, minute specks, something like eyes. From the anterior surface of the head originate the pectinated, or plume-like, branchiæ, collected into two bundles or tufts, but apparently forming a continuous circle when expanded. There are six branchiæ in each tuft, but it is rather difficult to ascertain the exact number: they are of a uniform yellowish colour. The mouth is inferior, and is encircled with not less than six tentacular filaments, of unequal length. Body tapered posteriorly, very distinctly annular; the segments shorter than their diameter, and armed on each side with a few short unequal

* Magazine of Natural History.

bristles: a darker line down the middle marks the course of the alimentary canal, which runs straight from the head to the tail. Just below the head, and on each side of the intestine, there is a linear-oblong organ of a dark colour, which is in a state of constant alternate contraction and dilatation; and which, therefore, I presume to be the heart propelling forward the circulating fluid.

The genus sabella occurs in the Systema Naturæ of Linnæus, who, having no distinct knowledge of the variety of the inmates, placed in it every tube composed of particles of sand and broken shells united to a membrane by a glutinous cement. As at present restricted and defined, the genus may be considered as having been instituted by Cuvier, whose name Lamarck has uncourteously changed to that of amphitrite. It is one of the most beautiful and remarkable genera among the sedantary annelides; but the species now described differs from the typical species, in having more than two tentacular filaments at the mouth; so that the generic character of Cuvier and Lamarck will require some modification in order to the reception of it.*

THE WILD COTTON TREE.

The Mahor or wild cotton-tree grows in Cuba to a vast size: there is one on an estate called Santa Anna 100 feet high. Its trunk, which is 44½ feet in circumference at the base, rises to 65 feet without a branch or a single knot on its white bark. The branches are worthy of the stem, and cover a diameter of 165 feet. This immense tree is in itself a world, and shelters and feeds millions of insects; several parasitical plants attach themselves to it: wild pine-apples grow at the top, and the vine vegetates on its boughs, and letting its branches droop to the earth, furnishes a ladder for rats, mice, and opossums, which would find it difficult to climb up a smooth bark, and enable them to reach the pine cups, which form so many natural reservoirs for the rain water. The wood-louse founds extensive republics in this tree, and establishes its large and black cities at the juncture of some of the branches, from whence it descends to the ground by a covered way of which it provides two, one to ascend, and the other to descend. This little insect is of the size of a flea, is inoffensive, and a great treat to the inhabitants of the poultry-yard when given to them in the nest altogether.†

VOCAL MACHINERY OF BIRDS.

It is difficult to account for so small a creature as a bird making a tone as loud as some animals a thousand times its size; but a recent discovery has shown, that in birds the lungs have several

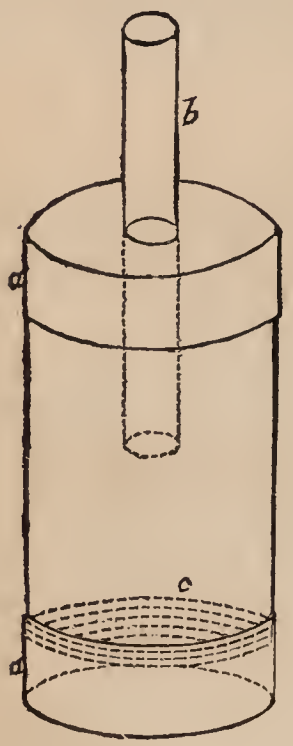
* Dr. George Johnston, in the Magazine of Natural History.

† Horticultural Register.

openings communicating with corresponding air bags or cells, which fill the whole cavity of the body from the neck downwards, and into which the air passes and repasses in the progress of breathing. This is not all; the very bones are hollow, from which air-pipes are conveyed to the most solid parts of the body, even into the quills and feathers. This air being rarified by the heat of their body, adds to their levity. By forcing the air out of the body, they can dart down from the greatest heights with astonishing velocity. No doubt the same machinery forms the basis of their vocal powers, and at once solves the mystery.*

DEVICE FOR SECURING CAPTURED INSECTS.

THE cut represents a small tin box, which has been found very convenient in collecting insects, particularly the larger species of hymenoptera and diptera: it consists of a tin bottle, having movable covers *a a*, fitting tight, both on the top and bottom; the upper one having a tube, *b*, let into it. A short distance from the lower end there is a false bottom *c*, pierced with very minute holes. In using this place a small piece of sponge, saturated with *liquor ammoniæ fortis*, below the false bottom, the fumes rising from which kill any insects which may be placed in the box. Insects with very bright colours should not be put in, as they are liable to be injured by the ammonia. It is manifest that, by leaving out the ammonia, the box may be used as a common collecting bottle. The figure is half of the size.



(The outline of this ingenious, and we should think, useful, device to entomologists have been communicated by Mr. C. Babington to the *Magazine of Natural History*.)

BATS.

BATS of the ordinary size, are very numerous in Jamaica; they are found in mills and old houses, especially such as are little occupied; they do great mischief in gardens, where they eat the green peas, opening the pod over each pea, and removing it very dexterously. Bishop Heber says, "the vampire bat of India is a very harmless creature, of habits entirely different from

* Gardiner's Music of Nature.

the formidable idea entertained of it in England. It only eats fruit and vegetables, and indeed its teeth are not indicative of carnivorous habits; and from blood it turns away when offered to it. During the day time, it is, of course, inert; but at night it is lively, affectionate, and playful, knows its keeper, but has no objection to the approach and touch of others." Mr. Waterton, however, when speaking in the "Wanderings" of the vampire of South America says, "there are two species in Demerara, both of which suck living animals; one is rather larger than the common bat, the other measures above two feet from wing to wing extended. So gently does this nocturnal surgeon draw the blood, that instead of being roused, the patient is lulled into a still profound sleep." The larger vampire sucks men and other animals; the smaller seems to confine itself chiefly to birds.*

MODE OF FISHING IN CHINA.

Among the many amusing scenes which strike the eye of a European on his first visit to China, is the ingenious mode of fishing which he sees practised in the neighbourhood of Canton. At the stern of their little punt-like boats, a small mast like a flag-staff, about eight feet high, is fixed. To the top of this a block is made fast, having a sheave to carry a one and a half inch rope. One end of this rope is fixed to a bamboo pole, twelve or fifteen fieet in length, and which is hoisted higher or lower, according as it is wanted. The butt end of the pole is kept inboard; and at the other end a light net, about eight feet square, is slung; being kept distended by two slender rods, fixed diagonally to the opposite corners, and bound together in the middle, where they cross each other; and where also they are fixed to the end of the swinging-pole. A stone is thrown into the middle of the net, to assist it in sinking, so that it may be, when down, spread out on the bottom of the river. When the fisherman thinks any fish are passing over the net, he suddenly hoists it above the water; and if he has made a capture, he swings the net inboard to take out the fish; if none are caught, the net is dropped again in the same or some other place.†

THE TARENTULA.

It is generally known that this name is given to a large spider, observed at first in the neighbourhood of Tarentum in Italy, and for the bite of which, considered poisonous, music and dancing were said to be the only remedy. M. Leon Dufour has collected some facts respecting this insect, and communicated them to the Academie des Sciences, in a letter read at one of their late meetings, from which are the following particulars. This spider

* Magazine of Natural History. † Ibid.

belongs to the genus *lycosa* founded by Latreille. These are chiefly met with in the south of Europe. To understand the manners of this insect it is necessary to notice the following peculiarities in its structure. The jaws and feet are large and strong; the second joint of the legs and the first of the feet are furnished with long stiff spurs, movable at their base, which are of much use to the animal in seizing and holding its prey: the first two pair of feet are furnished underneath with a down, arranged like a brush, which the tarentula employs in making its toilette, and in assisting it to crawl on smooth surfaces: finally the feet are terminated by two strong nails. It prefers inhabiting dry, arid, bare situations. The cylindrical burrows, which it forms, are about an inch in diameter, and sunk to the depth of a foot beneath the surface. The construction of this burrow is such as not only to protect the animal from the pursuit of its enemies, but to serve it as an observatory whence it may dart on its prey. At first the hole sinks perpendicularly, but at a depth of four or five inches bends and forms an almost horizontal elbow, after which it again resumes its direction downwards. It is just at this bend that the tarentula stands sentry, turning towards the entrance of its dwelling, eyes that sparkle and gleam in the dark. The external orifice of the burrow is usually surmounted by a funnel an inch in height, and two inches in breadth, so that it is wider than the burrow itself, a circumstance that admits of the extension of the claws necessary to enable the animal to seize its prey. The funnel is chiefly composed of pieces of dry wood united by potters' clay, and lined inside with a web spun from the spinnerets of the *lycosa*, and continued through the whole interior of the burrow. The utility of this is obvious, in preserving the hole clean, preventing the falling in of earth, and enabling the tarentula by its claws quickly to ascend. The tarentula, though so disagreeable in appearance, is easily tamed. M. Dufour had one for five months in a bottle, and it would come and take a live fly out of his hand. After having destroyed its victim with the hook of its mandibles, it did not content itself, as most spiders do, with merely sucking its head, but bruised the whole body, moving it through its mouth by means of its feelers; after which, it rejected the integuments and swept them away from its dwelling. After a repast it seldom failed to make its toilette, that is, it cleansed with the brushes of which we have spoken, its feelers and jaws; it then resumed its attitude of immovable gravity. The evening and night were the times at which it took exercise and attempted to escape: these nocturnal habits confirm the opinion of our author, that the most part of the spider tribe have the faculty of seeing both night and day. Six weeks after being taken, the captive tarentula changed its skin, and this moulting, which was the last, made no perceptible difference in the colour or size of its body. It supported at two

different periods a fast of nine days without appearing to suffer. It escaped while the author was absent.*

ON THE LUMINOSITY OF THE SEA.

From the German of Baron De Humboldt.

In the immense waters of the deep, animal life is very profusely distributed, and particularly gelatinous worms are so numerous, as to bestar the surface of the ocean and transform it into a sea of flames,—a spectacle which stamped upon my memory an ineffaceable impression, and always excited fresh astonishment, although it was renewed every night for months together. It may be seen in every zone; but those who have not witnessed it within the tropics, and above all upon the main ocean, can form but a very imperfect conception of the grandeur of the phenomenon; particularly if the spectator places himself in the shrouds of a ship of the line, during a fresh breeze, when she ploughs through the crests of the waves, and, at every roll her side is raised out of the water, enveloped in ruddy flames, which stream like lightning from the keel, and flash towards the surface of the sea. At other times, the dolphins, while sporting in the waters, trace out sparkling furrows in the midst of the waves.

Le Gentile and the elder Forster, explained the phenomena of these flames, by the electric friction of the waves against the hull of the ship, as it advances. But according to our present knowledge of physical causes, this explanation is inadmissible.

There are few points of natural history which have been so long and so much disputed, as the illumination of the sea water. All that is known with any certainty, may be reduced to the following facts: there are several shining mollusca which, during their life, emit at pleasure a phosphoric light, which is rather pale and generally of a bluish colour; this is observed in the *Nereis noctiluca*, the *Medusa pelagica*, var B., and the *Monophora noctiluca*, which M. Bory St. Vincent has recently discovered during the expedition of Captain Baudin. The microscopic animals which Forster saw swimming in innumerable multitudes on the sea, near the Cape of Good Hope, are of this number, and still undefined. The luminosity of the sea is sometimes, occasioned by these living lights; I say sometimes, as more frequently, although the animals increase in size, none can be perceived in the luminous water; yet whenever the waves strike against a hard substance and disperse in foam, particularly where the sea is greatly agitated, we perceive a gleam of light similar to lightning. The source of this phenomenon is probably the decomposed fibres of the dead mollusca, which abound in the depths of the sea; when this luminous water is strained through cloth of a close texture, these fibres are sometimes sepa-

* Athenæum.

rated in the form of luminous dots. When we bathed at night in the Gulf of Cariaco, near Cumana, some parts of our bodies remained luminous after coming out of the water, the luminous fibres attaching themselves to the skin. From the immense quantity of mollusca dispersed in all the seas of the torrid zone, it is not astonishing that the sea should emit light, although we cannot extract from it organic matter. The infinite division of the dead bodies of *Dagysæ* and *Medusæ*, may lead us to consider the entire sea as a gelatinous fluid, which consequently is luminous, has a nauseous taste, is unfit to be drunk by man, but is nourishing to many fish.

If a board be rubbed with a part of the Medusa hysocella, the part rubbed becomes again luminous whenever a dry finger is passed over it. During my voyage from the south to America, I sometimes placed a *medusa* on a pewter plate. If I struck the plate with other metal, the least vibration of the pewter was sufficient to make the animal shine. Now, I may ask, how did the shock and vibration act in this case? Did they immediately raise the temperature? Did they discover new surfaces? Or, did the shock elicit the phosphoric hydrogen gas, which, coming in contact with the oxygen of the atmosphere, or of the sea water, cause this appearance? The effect of a shock, which excites light, is most astonishing in a troubled sea, when the waves dash against each other in all directions. Between the Tropics, I have seen the sea luminous in all temperatures; but it was more so on the approach of a tempest, or, when the sky was lowering, stormy, or obscured. Cold and heat seem to have little influence on this phenomenon; for on the sand-banks of Newfoundland, the phosphorescence is often very strong in the most rigorous period of winter. Sometimes, all circumstances being apparently equal, the phosphorescence is considerable during one night, and scarcely visible the night following. Does the atmosphere favour the escape of light, or this combustion of phosphoric hydrogen? or do these differences depend on chance, which conducts the navigator into a sea more or less filled with the gelatine of mollusca? Perhaps these shining animalcules come to the surface of the sea only when the atmosphere is in a certain state. M. Bory St. Vincent asks, with apparent reason, why our swampy fresh waters, filled with *polypi*, are not luminous? It would seem that a peculiar mixture of organic particles is necessary to favour the production of light; the wood of the willow is more frequently phosphorescent than that of the oak. In England, they have succeeded in rendering salted water luminous, by throwing into it the brine of herrings. On most other points, galvanic experiments prove, that the luminous state of living animals depends on the irritation of the nerves. I have seen a dying fire-fly (*Elater noctilucus*) emit a strong light when I touched its anterior extremities with pewter or silver.*

* Field Naturalist's Magazine.

STUFFED ANIMALS.

M. LAURENT, a distinguished French naturalist, recommends the following composition, after ten years' experience, for preserving the skins of stuffed animals. He observes, at the same time, that it penetrates them with greater readiness, and preserves them much better than any preparation which has hitherto been in use: Arseniate of potash, sulphate of alumine, and camphor powdered, 2 dr. each; white soap in powder, ½ oz.; spirits of wine, 6 oz.; essence of thyme 30 drops. The arseniate, sulphur, camphor, and soap, are to be placed in a phial with a large mouth, and the spirits of wine to be poured upon them at 25°. They will be perfectly combined in 24 hours' time, when the essence of thyme is to be added, and then the phial is to be carefully corked down. This composition is to be shaken together before it is made use of, and it is to be spread over the coat of the animal with a brush.*

ON THE DOMESTIC CAT.

By a Correspondent of the Field Naturalist's Magazine.

THE sagacity of animals in shunning disease has been observed by several naturalists, particularly among gregarious animals, who are constantly found to avoid such as are affected with any complaint. Domestic animals are not generally so remarkable for this propensity, as their habits are associated with those of man. A cat I have, however, has exhibited a remarkable instance of sagacity during the present epidemic. She had been in the practice of coming up to my bed-room every morning to drink out of my ewer; but during the continuance of the febrile symptoms attending the influenza, she did not come to drink, and never entered the room. No sooner, however, had the fever subsided, than she immediately returned, and took her morning draught as usual. This shows that the senses of animals, particularly that of smell, must be extremely acute, and that the diseased atmosphere, however insensible we may be to its effect, has a powerful influence on their more acute organs.

REASON OF CATS ALIGHTING ON THEIR FEET IN FALLING.

THE instinct which all animals seem to possess in bringing the line of direction of the centre of pressure within the base is admirable. It is this instinct which renders the wild goat and the chamois so fearless of danger in the terrific leaps they take among Alpine precipices; and which enables a cat always to alight on its feet in falling from heights that appear sufficient to render a fall fatal. Now the operations of instinct, though in many points of view not a little miraculous, are always regulated by some

* Quarterly Journal of Agriculture.

ingenious principle, when that can be discovered; and in the instance of the cat always falling on her feet, it appears to me that the same principle operates which enables us to walk upright by regulating our centre of pressure according to the things around us. In learning to walk, we judge of the distances of the objects which we approach by the eye; and by observing their perpendicularity determine our own. Hence it is that no one who is hood-winked can walk in a straight line for a hundred steps together; and for the same reason most people become dizzy when they look from the summit of a tower or battlement much raised above the objects in the sphere of distinct vision. A whirling wheel or the current of a rapid river, or the apparent motion of the sea on looking over the side of a fast sailing ship, have often a similar effect. When a child can first stand erect on his legs, if you gain his attention to a white handkerchief tended like a sail, he will stand firm, but the instant you wave it he will tumble down. It is for this reason that rope-dancers, who have a very narrow base upon which to maintain the line of direction perpendicular, keep their eye fixed on a point of the framework upholding the rope by which to regulate their centre of pressure, and for the same reason those who perform difficult feats of balancing keep their eye fixed on the top of the things balanced, to retain the line of direction within the base. It may be accordingly infered that the reason why a man loses his balance when tipsy is, that his eyes roll so unsteadily as to prevent him from regulating his balance by the things around him, while the muscular feelings that assist him when hoodwinked are also deranged.

It would be curious to ascertain whether a cat, if rendered tipsy, would fall equally on her feet when dropped from a height as a sober cat. The difficulty of the experiment would lie in getting a cat to drink beer, wine, or spirits, all of which it greatly dislikes. I have no doubt, indeed, that it is by fixing the eye on the things around, that a cat falling from a height regulates her centre of pressure, so as to fall on her feet. She is, however, aided in this by the form of her body, somewhat the reverse of that of a greyhound, the centre of pressure lying far back from the head, and consequently bringing down the hind feet rather before the fore feet.*

THE LAMPLIGHTER INSECT.

This astonishing insect is about one inch and a quarter in length; and, what is wonderful to relate, she carries by her side, just above her waist, two brilliant lamps, which she lights up at pleasure with the solar phosphorus furnished her by nature. These little lamps do not flash and glimmer like that of the fire-fly, but

* Rennie's Alphabet of Physics.

give as steady a light as the gas light, exhibiting two perfect spheres, as large as a minute pearl, which afford light enough in the darkest night to enable one *to read print by them!* On carrying her into a dark closet in the day time, she immediately illuminates her lamps, and instantly extinguishes them on coming again into the light. But language cannot express the beauty and sublimity of these lucid orbs in miniature, with which nature has furnished the queen of the insect kingdom.*

ON THE PROBABLE NUMBER OF SPECIES OF INSECTS IN THE CREATION.†

By J. O. Westwood, Esq., F. L. S. &c.

Our great and pious naturalist John Ray ("le premier véritable naturaliste pour le rêgne animal," as the equally great Cuvier has styled him,) in his *Wisdom of God in the Works of the Creation*, published at the close of the seventeenth century, tells us, respecting the number of British insects;—"The butterflies and beetles are such numerous tribes, that, I believe, in our own native country alone, the species of each kind may amount to 150 or more. The fly kind (if under that name we comprehend all the flying insects, as well such as have four as such as have but two wings, of both which kinds there are many subordinate genera) will be found in multitude of species to equal, if not exceed, both the forementioned kinds. The creeping insects that never come to be winged, though for number they may fall short of the flying or winged, yet are they also very numerous; as by running over the several kinds, I could easily demonstrate. Supposing, then, there be a thousand several sorts of insects in this island and the sea near it, if the same proportion holds between the insects native of England and those of the rest of the world as doth between plants domestic and exotic (that is, as I guess, near decuple), the species of insects in the whole earth (land and water) will amount to 10,000: and I do believe they rather exceed than fall short of this sum." Subsequently, however, in consequence of having discovered a greater number of English moths and butterflies, he was induced to consider that the total number of British insects might be about 2,000; and those of the whole earth 20,000.

* Field Naturalist's Magazine.

† It must be borne in mind, that the following observations do not apply to the number of individuals, but to the different kinds or species of insects. Those who have observed "a swarm of gnats at eventide," (which, in general, consists of myriads of individuals of the same species), will at once perceive how impracticable it would be to attempt to decide the former question. The numerical variation, however, which exists in the different species of insects, opens very interesting views of nature, and is a question well worthy of the attention of the entomologist.

Linnæus, in the 1761 edition of the *Fauna Sueciæ*, described 1,700 species of insects, inhabitants of Sweden:* and, in the 12th edition of the *Systema Naturæ*, the whole number of these animals (Swedish and exotic) with which he had become acquainted amounted to about 3,000.

Let us now look at the state of the science of entomology in the present day. Mr. Stephens has given us a *Catalogue* of named British insects, amounting to 10,000; and, since the time of its publication, numerous additions have been made to the list. It was a curious coincidence, that our poet of nature, Thomson, should have hit upon this very number, in order to give some idea of the vast profusion of summer insects: and Mr. Stephens has happily adopted the lines printed below in italics as his motto:—

> "By myriads, forth at once,
> Swarming they pour; of all the varied hues
> Their beauty-beaming parent can disclose.
> Ten thousand forms! *ten thousand different tribes*
> *People the blaze.*"

Mr. MacLeay, whose general knowledge of the extent of modern collections cannot be questioned, stated, in the second part of his *Horæ Entomologicæ*, (p. 469), published in 1821, that there were certainly more than 100,000 of the annulose animals (nearly synonymous with the Linnæan insects) preserved in the various collections.

Messrs. Kirby and Spence, adopting a conjecture of Decandolle, that the number of species of plants may be somewhere between 110,000 and 120,000, observe, that, "as a vast number of phanerogamous plants and fungi are inhabited by several species (of insects), we may form some idea how immense must be the number of existing insects; and how beggarly does Ray's conjecture of 20,000 species, which in his time was reckoned a magnificent idea, appear in comparison!" After instituting a comparison between the numbers of British insects with that of British phanerogamous plants, whereby it appears that, on the average, there are more than six insects to each plant; these authors arrive at the conclusion that, "if we reckon the phanerogamous vegetables of the globe, in round numbers, at 100,000 species, the number of insects would amount to 600,000." If we say 400,000, we shall, perhaps, not be very wide of the truth.

With respect to the relative proportion of the different orders to each other, Messrs. Kirby and Spence state, that the Coleoptera may be considered as forming at least one to two of our entire insect population. Now, however, that the same attention is bestowed upon the minuter Hymenoptera, Diptera, and Lepidoptera, as has been long given to the small Coleoptera, we find this cal-

* This was in his day considered so remarkable a fact, as to induce Reaumur to assert that Sweden was richer in the number of its insects than any other country in the world.

culation gives too great a share to the beetles. In Mr. Stephen's Catalogue, they barely reach one third of our native insects. If, therefore, we take the group of predaceous beetles (being the one which has been most recently investigated in the detail of its species with all possible advantages and assiduity by Dejean), we find that, although it did not bear, in the Systema Naturæ, a greater proportion to the whole order of beetles than one to sixteen, yet not only in Stephens's Catalogue of the English species, but also in the general Catalogue of Dejean, the proportion which it bears to the whole Coleoptera is about one to sixteen. And, as I have already stated that the number of species described by Dejean may be averaged at 2,000, the whole number of beetles, at the above rate, would not exceed 16,000; and, by adding 4,000 more for other known species, the number would not exceed 20,000: and yet Count Mannerheim, in his recent monograph upon the Staphylinidæ, states that Dejean had informed him, in 1830, that he then possessed nearly 18,000 Coleoptera; and the baron himself informed me, two years ago, that he possessed between 20,000 and 21,000 Coleoptera. And by estimating the beetles, as above, at one to three of the insect tribes, we shall only obtain 60,000. What a wide field, therefore, remains to be investigated, before we shall become acquainted with the 600,000 or even 400,000 species supposed by Messrs. Kirby and Spence to exist; and how absurd does it seem to consider our systems, or rather system, as firmly established, whilst so little is comparatively known!*

LITTLE BUSTARD.

A SPECIMEN of this rare bird was shot on Berry Down, in the parish of Lanreath, among the heath, September 23, 1831. Its weight was 1 lb. 14 oz.; length from bill to tail, 18 in.; to the toes, 19½ in.; expanse of wings, 2 ft. 11 in. The plumage was such as is figured by Bewick, and described as that of the female, having no black, or band of white, about the neck; yet, on dissection, it proved to be a male. As a remark similar to this has been made before, it becomes a question whether, in fact, the male, after moulting, does not assume the plumage of the female?†

AFFECTIONATE CLEANLINESS.

IT is a very curious provision made by nature, that the dung of all nestlings is inclosed in a thin membrane, which enables the old birds to carry it away in their bills, which they do regularly each time they bring food to the nest. The young instinctively, even before they can see, protrude their hind quarters to eject the dung from the nest; but, if the parent did not carry it away,

* Magazine of Natural History. † Ibid.

there would be a congeries of dirt under the nest, which would not only be uncleanly, but would attract attention and discover their retreat. As long as young birds are kept to their nest in a basket, or box, the membranous covering continues; if they are let out to perch, it ceases; if they are shut down again in the nest, or basket, it re-appears. The warmth and quiescence of the nest certainly occasion it, and principally the quiescence; but how it should have that effect, the writer cannot pretend to understand. It is a marvellous provision of Almighty wisdom.*

SERVICES OF THE ROOK TO MAN.

By a Correspondent of the Magazine of Natural History.

A STRONG prejudice is felt by many persons against rooks, on account of their destroying grain and potatoes; and so far is this carried, that I know persons who offer a reward for every rook that is killed on their land; yet so mistaken do I deem them, as to consider that no living creature is so serviceable to the farmer, except the live stock he keeps on his farm, as the rook. In the neighbourhood of my native place is a rookery belonging to W. Vavasour, Esq., of Weston, in Wharfdale, in which it is estimated there are ten thousand rooks, that 1 lb. of food a week is a very moderate allowance for each bird, and that nine-tenths of their food consist of worms, insects, and their larvæ; for, although they do considerable damage to the fields for a few weeks in seedtime and a few weeks in harvest, particularly in backward seasons, yet a very large proportion of their food, even at these seasons, consists of insects and worms, which (if we except a few acorns and walnuts in autumn) form at all other times the whole of their subsistence. Here, then, if my data be correct, there is the enormous quantity of 468,000 lbs., or 209 tons, of worms, insects, and their larvæ destroyed by the birds of a single rookery; and to every one who knows how very destructive to vegetation are the larvæ of the tribes of insects (as well as worms) fed upon by rooks, some slight idea may be formed of the devastation which rooks are the means of preventing. I have understood that in Suffolk, and in some of the southern counties, the larvæ of the cockchafer are so exceedingly abundant that the crops of corn are almost destroyed by them, and that their ravages do not cease even when they have attained to a winged state. Various plans have been proposed to put a stop to their depredations; but I have little doubt that their abundance is to be attributed to the scarcity of rooks, as I have somewhere seen an account that rooks in those counties (I have not been in them) are not numerous, either from the trees being felled in which they nestled, or that they had been destroyed by the prejudiced farmers. I am the more inclined to be of this opinion, because

* Field Naturalist's Magazine.

we have many rooks in this neighbourhood, where the cockchafer is not known as a destructive insect; and I know that insects of that class and their larvæ are the most favourite food of the rook.

I will mention another proof of the utility of the rook, which occurred in this neighbourhood many years ago:—A flight of locusts visited Craven, and they were so numerous as to create considerable alarm among the farmers of the district. They were, however, soon relieved from their anxiety; for the rooks flocked in from all quarters by thousands and tens of thousands, and devoured them so greedily that they were all destroyed in a short time. Such, at least, is the account which is given; and I have heard it repeatedly mentioned as the reason why the late Lord Ribblesdale was so partial to rooks. But I have no means of ascertaining how far this is true, except general report.

It was stated in the newspapers, a year or two back, that there was such an enormous quantity of caterpillars upon Skiddaw, that they devoured all the vegetation on the mountain, and people were apprehensive they would attack the crops in the inclosed lands; but the rooks (which are fond of high ground in the summer), having discovered them, in a very short time put a stop to their ravages.

THE NIGHTINGALE.

THE following singular fact is taken from a note relating to this bird, in the Rev. Mr. Bowles's "History of the Antiquities of Locock," (which will shortly be published). "Of the character of the song of the nightingale, (says Mr. Bowles), Mr. Coleridge has spoken as being lively and not melancholy. But neither Mr. Coleridge, nor any ornithologist, to my knowledge, has remarked what, I have no hesitation in saying, will be found a fact:—The nightingale has no note of its own, except in commencing its rich and varied song, the first short whistle, and succeeding—jug—jug—as if to prepare itself for its elaborate and rich song. It invariably opens, or, I should say, *preludes* its song, only with those two, its native notes. It then distinctly, and literally as a *mocking bird*,* pours out with richer, louder, and more mellow tones, the identical notes in rapid succession of other singing birds, from the notes of the thrush, the blackbird, the yellowhammer, the lark, the red-breast, the wren, &c., until it is tired. This I know from those who can instantly pronounce, from the song which they hear, what bird sings. Another remarkable fact may be mentioned. The nightingale never sings without a twig upon which it can rest its breast whilst it sings, as if to assist it in exerting all its powers, and for this reason, it always lays a twig across its nest, for the purpose of teaching its young to resort to the same assistance in their future

* See "Habits of Birds," chap. xvii. for a refutation of all this.—*Rennie.*

song. While I am on the subject, I may remark another curious fact. The bulfinch naturally has only one note, and that dull. To sing, it must have the regular instruction of art, and then it learns its varied song in cottagers' houses. It may be taught the perfect scale of eight notes, with the half and the whole notes, and modulate exactly any tunes, or bits of tunes, its music master teaches."*

CAPRELLA ACUMINIFERA AND NYMPHUM COCCINEUM.

By George Johnston, M. D.

The first figure (fig. 1. *a*) represents the caprella acuminifera, a small crustaceous insect, which has not, so far as I am aware, been previously honoured with a portrait. Mine was drawn from an individual captured among some corallines that had been dredged up in Berwick Bay. The "living anatomy" in question attracted attention by its motions to and fro in the basin, and might have easily escaped the fatal notice of him who thus stamps it with immortality, had it remained at rest; for, from its very slender form and colourless body, it is scarcely distinguishable in that state. The motions of the creature are quick and awkward, propelling itself forward by alternate archings and elongations of the body, in the manner of many caterpillars: but its superior rapidity is probably derived from the branchial processes, that are obviously well fitted for the purpose of oars, whatever other function they may fulfil.

Caprella acuminifera is about half an inch in length, very slender, pellucid, and colourless, except at the joints of the legs and the vesicular processes, which are spotted with red. The superior antennæ are as long as the body, and the last articulation of these is as long as the four inferior, being composed of a number of short joints, that are bristled with very short cilia. The inferior antennæ are half the length of the others; and beneath them we observe the short articulated palpi. The eyes are round and scarlet; head obtuse, with a spinous process above the front, and two less ones behind; first pair of hands small; the second much larger, oval, serrated on the inner margin, with a toothlike process above, and armed with a curved sharp claw. The joints of the wrist are short; the branchial one lengthened. The vesicular or branchial processes are in pairs, oval, and compressed; they appear to consist of a bladder filled with an opaque matter, and are connected with an anterior vesicle, situated just at their base. The three hinder joints of the body are each furnished with a pair of slender monodactyle legs, the last articulation of which is slightly curved, and, besides its tooth at the upper side, is minutely serrated and grooved on the inner edge for the reception of the claw. A straight intestine runs

* Field Naturalist's Magazine.

down the centre: but I could not observe any trace of a circulating system.

I do not know to whom the discovery of the animal just described is due: it is probably to Montagu: but I claim the subject of the second figure (*b*) as my own. I have already given a description of it in the third volume of the Zoological Journal, page 489, where it is named

NYMPHUM COCCINEUM;

and I shall not be the first to change the designation, although some parts are wanting that are generally deemed essential to the species of that genus. The description is as follows:—Body and legs slender, of nearly equal thickness, of a uniform fine transparent red colour, with the joints and tarsi yellowish. Rostrum yellowish: mandibles like the body. When magnified, a central vessel, distinguished by its deeper tint, is seen running uninterruptedly through the body and legs; and the latter are somewhat clothed with very soft white delicate hairs. Rostrum cylindrical, subclavate, not jointed, divided beneath by a longitudinal line, terminal. Mandibles two, originating from the first segment of the body, biarticulate; basal joint long, second short and ovate, armed with two small equal claws. Body four-jointed; tubercule oculiferous; eyes two? Legs eight, three times the length of the body, equal. Coxæ four, articulate; the two basal joints short and equal, the two following a little longer. Thighs as long as the coxæ, very slightly dilated. Tibiæ of two equal joints, each nearly as long as the thigh. Tarsi tri-articulate, first minute, second rather long, falciform, with a few teeth on their internal edge, and terminated by a single rather long claw. Tail without any appendage.

I have seen five or six specimens of this singular creature, and

they were all alike in size, shape, and colour; so that there can be no doubt of its being perfect in all its parts. It lives among sea-weeds in Berwick Bay; and when at rest, with the legs drawn up, it so closely resembles some of the fine coloured confervæ, but more especially a detached portion of the Chondria articulata, as to be easily overlooked. It appears to me interesting, in so far as its transparency allows us to examine its circulating system with an accuracy which perhaps no dissection could enable us to amend. Close to the tubercle we see the vessel (for there is no heart) divide into two equal branches, one to each mandible; and the flux and reflux of a fluid is easily observable in them. From the tubercle the vessel runs down the body, giving off a single branch, equal in size to the trunk, to each leg; and this branch continues uninterrupted to the tarsus. Neither in the trunk nor branches could I perceive any movement of the fluid.*

ANATOMY OF THE SLOTH.

On March 19, at the Linnæan Society, a communication from Professor Buckland was read, "On the adaptation of the structure of the Sloth to its peculiar mode of life." The opinion of mankind in general, as well as of all naturalists to the present time, has been, that the sloths are instances of imperfect organization. Differing in many respects in their plan of structure from other quadrupeds, every difference was considered to be a defect; and hence they were supposed to be condemned to lead a life of misery. Cuvier remarks, that the elephant alone varies in as great a degree as the sloth, from the general plan of nature in the formation of this class; but the variations in the elephant correspond with one another, so as to produce a harmonious result adapted to its habits, "mais dans le paresseux chaque singularité d'organization semble n'avoir pour resultat que la faiblesse et l'imperfection, et les incommodités qu'elle apporte à l'animal ne sont compensées pas aucune avantage." (*Ossemens Fossiles*, vol. v. part 1. p. 73.)

These notions have arisen from a want of attention to the habits of the animal, which are described by Professor Buckland, from the information of Mr. Burchell, and by quotations from the works of Piso and Marcgrave, and Mr. Waterton.

The sloths spend their whole lives in trees; and the forests of Brazil, and other parts of South America where they are found, are generally so dense, that they can move from tree to tree by the interwoven branches without descending. When obliged to come down, their passage on the ground, to reach the next nearest tree, is attended with much difficulty, as they are not formed for walking. Their food consists of the young leaves

* Magazine of Natural History.

and buds; and these furnish them with sufficient moisture, for (as Mr. Burchell observed in the case of several which he kept) they never drink.

They climb trees with ease, and hang to the branches by their long and curved claws. In this position, suspended with their back downwards, they move along under the branch with facility, and sufficient rapidity to surprise those who have observed only their awkward attempts at progression on the ground. They generally sleep in the fork of a branch, with all their four legs clasped round it.

Professor Buckland examines in detail the anatomical structure of these animals, and quotes the accounts given by authors who have written upon them; from which it is shown, that so far from the peculiarities of their form and organization being sources of inconvenience and instances of imperfection, they are beautiful adaptations to their peculiar habits.

The position of the feet, and the form and size of the claws, are admirably suited for grasping a branch; and the length of the arm and fore-arm enables them to reach the end of the branches which are too slight to bear their weight.

It has long been observed, that the sloth differed from all the other mammalia in the number of the vertebræ of the neck, which are nine, while all the rest of the class have only seven. Hitherto, this deviation from the general plan has seemed to be without a motive; as it appeared, that where length and flexibility were required, these qualities were perfectly attained by lengthening each vertebra, without adding to the number of them. The reason of the exception is now pointed out. The sloth, in its inverted position, and confined in its line of march to follow the branch on which it is placed, requires the power of looking directly backwards. As a long neck would be an incumbrance, it has received an additional number of short joints, which enable it to turn its head within a short space.

This remark appears to have been first made by Mr. Burchell, who has observed these animals, with great facility, to twist their heads quite round, and look in the face of a person standing directly behind them.*

ACCOUNT OF THE CAPTURE OF A SEA-DEVIL.

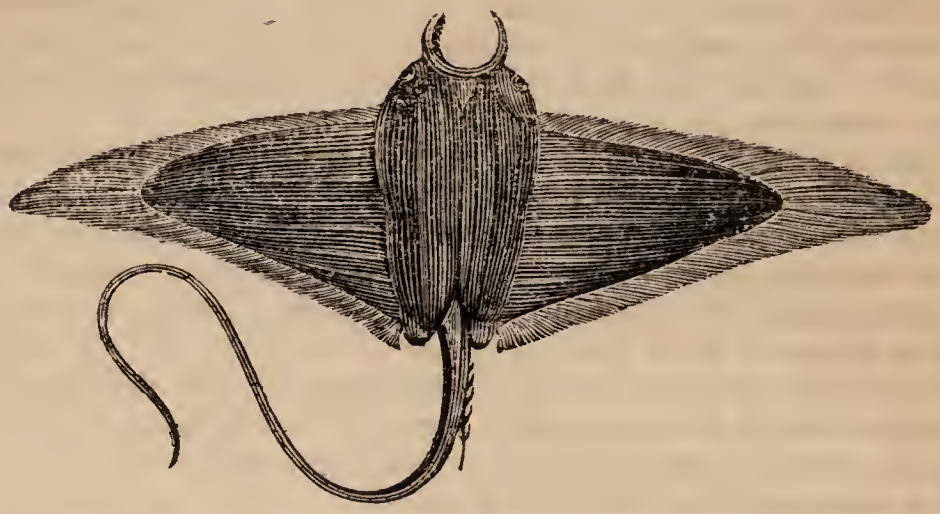
By M. Le Vaillant.

In the latitude 10° 15′ north, longitude 355°, we met with a calm that delayed us several days, and in the interval I witnessed a phenomenon, which, though known to our ship's crew, was to me perfectly novel.

An enormous flat fish, of the ray genus, came and swam round our vessel. It differed from the common ray, however, in the

* Philosophical Magazine.

shape of its head, which, instead of being pointed, formed a crescent, and from the extremities of the semicircle issued two arms, as it were, which the sailors called horns They were two feet wide at the base, and only five inches at the extremity. This monster, they told me, was called the sea-devil.



A few hours after we saw two others with this, one of which was so extremely large, that it was computed by the crew to be fifty or sixty feet wide. Each swam separately, and was surrounded by those small fish which usually precede the shark, and which are therefore called by seamen pilot fish; lastly, all three carried on each of their horns a white fish, about the size of a man's arm, and half a yard long, which appeared to be stationed there on duty.

You would have said they were two sentinels placed to keep watch for the safety of the animal, to inform him of any approaching danger, and to guide his movements. If he approached too near the vessel they quitted their posts, and swimming briskly before led him away. If he rose too high above the water, they passed backward and forward over his back, till he had descended deeper; if, on the contrary, he swam too low, they disappeared and we saw no more of them, because, no doubt, they were passing underneath, as in the preceding instance they had passed above him. Accordingly we found him re-ascend towards the surface, and then the two sentinels reassumed their posts, each on his horn.

During the three days that the calm continued, and we remained motionless for want of wind, these manœuvres were many times repeated before our eyes as to each of the three monsters.

I was desirous of catching one of them, in order to examine it at my leisure. But when I proposed it to the crew they treated it as impossible. However, on my promising a dozen bottles of wine to any one who should accomplish it, their ardour was roused; and the attempt, which was before deemed impracticable, was now only difficult.

They all ran to their harpoons, and posted themselves here and there by the ship's side in readiness to strike. A sailor standing near the bowsprit, more fortunate than the rest, struck one of these fish on the back, then, letting out his line that he might have room to beat about and tire himself, he at last towed him gradually to the surface of the water. The animal lay perfectly motionless, and we made no doubt of easily drawing him on deck. One harpoon, however, being insufficient to support him, particularly as it had penetrated but a little way, twelve or fifteen more were struck into him at once, so as to fix him completely: several hawsers were passed round his body, and he was thus hoisted on board.

This was the least of the three, being only eight-and-twenty feet in its extreme breadth, and one-and-twenty in length from the extremity of its horns to that of the tail. The tail, which was thick in proportion to the body, was twenty-two inches long.

The mouth, placed exactly like that of the ray, was wide enough to swallow a man with ease. The skin was white under the belly, and brown on the back, like that of the ray.

We reckoned the animal to weigh not less, certainly, than a ton. About twenty small sucking fish were fastened to different parts of his body so firmly, that they did not drop off when he was hoisted on board, but were taken with him.

Some naturalists have said, that the head of the sucking fish is viscous on the lower part, and furnished with rough points, similar to the teeth of a file; and, according to them, it is by means of these two qualities, its roughness and viscosity, that it is enabled to adhere to other fish.

"Figure to yourself," says one of them, "a row of nineteen sharp-edged and dentated laminæ, placed cross-wise, and issuing immediately from the rim of the lower jaw, and you will have a just idea of the part with which the remora makes itself fast."

This description is exact as far as relates to the figure and number of the dentated laminæ; but it places them on the lower part of the head, whereas they are, in reality, on the upper. Accordingly, when the remora fixes itself, it is obliged to turn upon its back, with its belly upward.

I am ignorant whether the two white fish that post themselves on the arms of the sea-devil, and appeared to serve him as pilots, were also of the remora kind. But this at least I can assert, that they appeared to stick firmly to the extremities of the arms I have mentioned, notwithstanding the arms were in continual motion. I must observe, however, that if these white fish had a flat surface, like that by which the remora adheres to other fish, it must have been on the lower part of the body, and not on the upper, since the animal continued in its natural position, and had no occasion to turn over to fix itself at its post.

It would have been highly gratifying to me, if these fish had remained at their stations, and allowed themselves to be taken with

the sea-devil, as I should then have had an opportunity of examining them; but the moment the first harpoon was thrown, they let go their hold and disappeared.

I hoped, however, that we might perchance catch one of those that served as sentinels to the other two monsters, which, by all the noise we had made, had not been driven away. Different baits were tried for them, but to no purpose; when the bait was thrown into the water, they came and examined it, and immediately returned to their posts.

I do not at present recollect that any naturalist has spoken of these white remoras. Yet other travellers besides me have seen them. I shall cite on this head Dubadier, known in natural history for his rare and ample collections of the crustacea of the Carribbee Islands. In his last voyage this naturalist saw, in latitude 45° north, longitude 333°, a similar ray, which he supposed to be about twenty-five or thirty feet in breadth, accompanied by its two white pilots. He made a drawing of it, as I did of the rays which I saw, and on comparing these drawings, the fish evidently appears to be of the same species.*

RECENT EXPERIMENTAL RESEARCHES ON THE PROCESS OF RUMINATION OR CHEWING THE CUD.

By Professor Rennie.

HAVING been led, while composing the "Alphabet of Zoology," lately published, to investigate minutely the process of digestion in different animals, I think it will be interesting to state here in brief the results of the recent investigation by M. Flourens, of the curious process of chewing the cud or rumination, which quite upsets all previous explanations.

This process is always connected, excepting individual instances, as in man and the kangaroo, with a complicated stomach, there being four, or at least four, distinct chambers whose structure is very different. The first, similar to the crop or craw of birds, is termed the paunch, and serves, by its heat and somewhat scanty moisture, to prepare the herbage for farther change. It is situated on the left side, and lined with a rough membrane studded with small flat projections. It is infered to have a rotatory motion, from the round masses of hair, called bezoar stones, frequently found in it, arising from the union of hairs licked off, from time to time, by the animal when cleaning itself, and said, without proof, to be miraculously medicinal. In the chamois, the bezoar stones appear to consist of vegetable matter.

The second is termed the honey-comb bag, king's hood, or bonnet, is much smaller than the paunch, and is situated on the right of the lower end of the gullet, which opens in common into it and into the paunch. On the inside a number of shallow cells, like those of a honey-comb, are formed by projecting membrane, and the whole is lined with a rough scarf skin continuous with that of the gullet and paunch.

The third is the smallest of the four, and is named the many-plies,

* Translated in the Field Naturalist's Magazine.

because the inner surface rises up into a great many folds, one above the other, amounting to about forty in the sheep, and about one hundred in the ox, and covered with a rough scarf skin. Some of these folds project farther than others, there being first two long ones on each side, and within these two shorter, and so on. The smallest of them, between the opening from the honeycomb bag, are puckered, so as to act as a valve between this third chamber and the fourth.

The fourth, which is exclusively the digestive stomach, according to Dr. Carus, is called the rennet bag, or red. Here, as in the simple stomachs of beasts of prey, we find no lining of scarf skin, which goes no farther than the many-plies; but a soft mucous membrane, which has the property of curdling milk, and that of the calf is used for this purpose in cheese-making.

It is important to observe, that, from the inlet of the paunch or first stomach, from the termination of the gullet, near the junction of the second and third stomachs, there runs to the third stomach a groove, which I shall call the cud-duct, with the first stomach on its left, and the second on its right. This cud-duct has thick prominent margins, which can be brought to meet so as to form a tube, and constitute a continuation of the gullet across the second into the third stomach. This duct was ascertained by M. Flourens to remain always open, even when the gullet inlet of the first stomach was closed.

The process of chewing the cud has recently been explained with great minuteness by M. Flourens, of Paris, who killed a number of sheep while in the act, for the purpose of investigating the facts, which have not been well understood by Aristotle, Perronet, Daubenton, Camper, Haller, Chabert, Foggia, and Bourgelat, and we may say the same of Grew, Monro, John Hunter, Blumenbach, and Carus.

When an ox or a sheep first swallows grass or other herbage, it passes chiefly into the paunch, but both partly, *immediately and successively*, into the second stomach; but in the instance of liquids, such as broth, a portion always passes into each of the four stomachs *immediately;* the only opening into the third stomach being very straight, and capable, also, of being quite closed, so as to prevent the passage of anything coarse. The reason why liquids pass into the third and fourth stomachs is, that unless the gullet-inlet into the first stomach is expanded by a morsel of solid food, the cud-duct is more open to receive the liquid, and for the same reason, the cud-duct is prevented, by the expansion of the gullet-inlet, from admitting solid food.

In the process of common vomiting, the contents of the stomach are, by the action of the midribs and the muscles of the belly, ejected in a mass; but in chewing the cud, there is only a small rounded pellet brought up into the mouth, so that the process is in this very different from vomiting. Bourgelat denied the existence of the pellet, and Daubenton says it is formed by the second stomach. M. Flourens ascertained, beyond all question, that the pellet or cud, (which is only a different way of spelling *quid*,) is detached from the mass of aliment in the paunch, by the latter contracting and pressing the mass upwards towards the adjacent inlets of the paunch, the many-plies, and the cud-duct, which seize and detach from it a portion about an inch in diameter. The space, also, which these several adjacent inlets inclose, being round, and its walls in motion, the pellet is thereby rounded, and at length pushed up into the gullet, and returned to the mouth.

It is very remarkable, that, during the formation of the pellet, a very

copious flow of spittle takes place from the mouth down the gullet, without which the pellet, which is rather dry at first, could not easily be brought up. The second stomach also, has, by its contraction, the opposite open cells brought into contact, so as to form a series of shut cells; an admirable provision for preventing the fluids, always more or less present here, from being brought up along with the pellet.

The pellet, when returned to the mouth is minutely chewed and reduced to a half fluid pulp, which, on being swallowed, is not solid enough to force open the always shut inlet of the paunch, and consequently enters the always open inlet of the cud-duct, and passes to the third stomach, from which it is forwarded to the fourth. The account of this process by Blumenbach, adopted by our British physiologists, is grossly erroneous.

In consequence of this complicated process, animals which chew the cud can digest more effectually than those which do not, such as the horse, it being common for the latter to pass corn quite undigested, a circumstance that rarely happens with horned cattle; and hence it is well known to graziers, that one third less will be enough for an ox than for a horse or an ass. According, however, to the recent experiments of De Dombaslea and Biot, this will depend, in the case, at least, of roots, such as carrots or potatoes, upon boiling, so as to break the globular crust enveloping the nutrient matter, which the stomach cannot well effect. This matter, formerly termed *Amidine*, from its occurring in starch, has been termed by M. Biot, *Dextrine*, from its polarizing the rays of light towards the right,—a singular property, by which the nutritive qualities of vegetables may be, M. Biot thinks, determined by optical experiments. If this be proved by farther research, it will furnish a triumphant answer to those who are disposed to ridicule minute and recondite inquiries, because they appear to be of no use. When the polarity of light was discovered, it certainly could never have been anticipated that it might become a test for the nutritive qualities of food.*

THE ORNITHORHYNCHUS.

On March 19, at the Linnæan Society, a notice was read, extracted from a letter from Capt. King, R.N., stating that Mr. J. MacArthur, of Paramatta, had a specimen of ornithorhynchus, from the mammæ of which he had squeezed a large quantity of milk. There were no nipples, but the milk oozed out through pores. This direct confirmation of the discovery of Professor Meckel appears to have been obtained in New South Wales, about the same time that Mr. Owen was demonstrating the same fact (as published in the Phil. Trans. for 1832) from the anatomical examination of specimens in England.†

THE HONEY BUZZARD IN IRELAND.

At a meeting, on July 23, 1833, of the council of the Belfast Natural History Society, Mr. W. Thompson, V. P., stated, that on the 11th of June last, a fine female specimen of the honey

* Field Naturalist's Magazine. † Philosophical Magazine.

buzzard, which is unrecorded as having ever before occurred in Ireland, was, when in company with a similar bird, most probably the female, shot by Robert George Bomford, Esq., in his demesne of Annadale, in the vicinity of Belfast: and who, on being informed of the rarity of the bird, had most handsomely presented it to the Belfast museum. Mr. Thompson, who saw the specimen when fresh, related that the bill and forehead were covered with cow-dung, in such a manner as to lead him to suppose that the bird had, in that excrement, been searching for insects. On examination of the stomach, which was quite full, it was found to contain a few of the larvæ, and some fragments of perfect coleopterous insects; several whitish-coloured hairy caterpillars; the pupæ of a butterfly, and also of the six-spot burnet moth (Zygæna filipendulæ); together with some pieces of grass, which, it is presumed, were taken in with the last-named insect, it being on the stalks of grass that the pupæ of this species of Zygæna are chiefly found. Mr. Thompson remarked that this insectivorous food must, to the honey buzzard, have been a matter of choice, the bird being in the full vigour of its powers, and the districts in which it was killed abounding with such birds as, were they its wished-for prey, it might have easily captured and destroyed.*

NEW OBJECT FOR THE MICROSCOPE.

Dr. Goring and Mr. Andrew Prichard, in their lately published *Microscopic Illustrations*, submit the following as a new object—the larva of a species of British Hydrophilus, or Water-Devil, natural size and magnified.

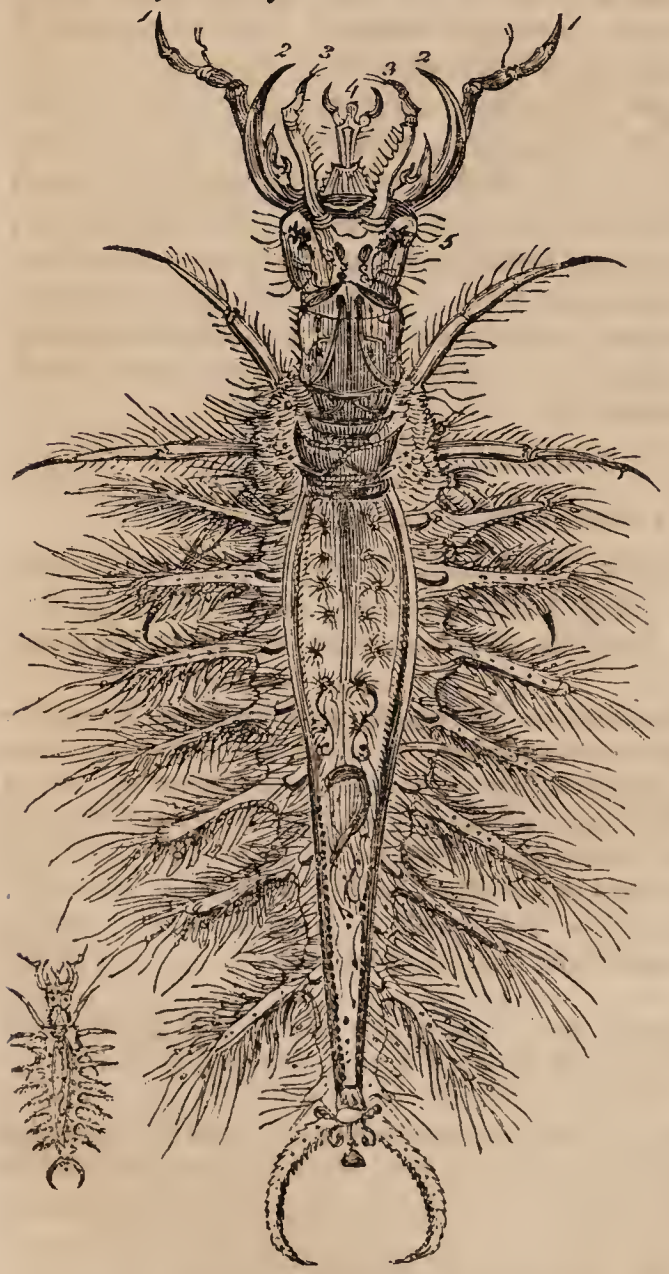
It is nearly allied to the *Dytiscus*, or Diver, its popular name bespeaks its savage propensities; and in examining its peculiar structure and habits, the faculty which most strikingly attracts our attention, is its ferocious disposition, and the fitness of its organs for the exercise of its ravenous appetites. Its size is but little inferior to that of the larva of any of the British Coleoptera, as it measures, when arrived at maturity, an inch and a half in length, while the superior strength and courage manifested in its attacks on small fish, and other animals larger than itself, is truly surprising.

About the latter end of April, and during the month of May, small nests of these insects are often found floating among the weeds and water plants, in stagnant pools. They are in the form of balls, of a dusky white colour, and a silky texture, and have each a small stem of the same nature as the nest, by means of which it is attached to the roots or stalks of weeds at the bottom of the water. In this situation it remains during the winter, and is thus effectually preserved from the effects of intense cold. Early in the spring, the stem or cable to which we have referred, is detached from the weeds, by the winds which at that time prevail, and the nest rises to the surface of the water, and there floating, imbibes the genial influence of the sun. These nests may be taken and placed in a basin of water, and, as the season advances, hatched by the heat of the

* Magazine of Natural History.

sun. On the larvæ leaving the nest, which they accomplish by gnawing a hole in the side, the infant larva immediately descends to the bottom of the vessel, with its jaws extended in search of prey, and eagerly devours all the small aquatic insects that are within its reach; if, however, there is a scarcity of food in the immediate neighbourhood of the nest, the larva of the same brood may be seen to attack and devour each other.

In its infant state this larva is very transparent; hence its internal structure may be clearly distinguished. The circulation along the principal artery on each side of the body can be distinctly observed, together with the violent alternate motion of the vermiform body, near the lower extremity. It is at this time about a quarter of an inch in length, and swims very nimbly.



The manner in which this larva treats its prey, evinces an extraordinary degree of instinct. Many of the creatures on which it feeds, are crustaceous about the head and back; hence their most vulnerable part is the belly. This part, therefore, the larva attacks, and to accomplish its aim, swims underneath the intended victim, and bending back its head, which is even with the surface of its back, is enabled to reach its prey by means of its jointed anteunæ, 1, which represents a magnified view of the larva taken while young. Its next operation is to pierce it with the mandibles, 2. Having thus secured its object, it immediately ascends to the top of the water, and holding its prey above the surface, so as to prevent it struggling, shakes it as a dog would a rat. The prey, however, of this larva is often larger than its destroyer. Its next operation is to insert the piercer and sucker, 4, which is capable of being thrust out or withdrawn at pleasure. When the juices of the victim are not easily procured by suction or exhaustion, the serrated pair of forceps, *c*, is employed to tear and masticate it, and thus cause the juices to be more easily obtained. If its food is plentiful, this larva arrives at its full growth in the course of three or four weeks, and is then nearly opaque, and thickly covered with

hair. It can be kept several days without food, and by this exinanition its structure becomes considerably more transparent,* while its natural ferocity is greatly increased, so that it will attack and fight with creatures much larger than itself, and even with its own species.

On a fine sunny day the larvæ arise to the surface of the water, and delight to bask in the sun, but if watched they remain motionless, with their claws extended. If a stick, or any other substance, be presented to them, they will immediately sieze it, and will sometimes suffer themselves to be cut into pieces before they relinquish their hold. Their bite has been considered poisonous by many persons, as it takes a greater length of time to heal than other wounds of the same extent, so that caution should be used in taking them.

Touching the anatomy of this creature, it may be observed, that the sucker, marked 4, is contained in a crustaceous sheath, and may be considerably protruded or completely withdrawn at the pleasure of the larva: in the engraving it is shown extended to about three quarters of its length. The eyes are compound, but of a peculiar conformation, being composed of seven oval lenses, arranged like leaves upon a branch; in the drawing they are denoted by the figure 5. The whole of the head and thorax is curiously marked with a number of lines and spots. The legs are six in number; they are thickly set with rows of hair on their opposite sides, and each is furnished with a sharp claw. The number of swimmers on each side is seven; they are covered with hairs, and in the specimen from which the drawing was taken, a vast number of *vorticella*, or bell polypi, were attached. These will be recognised in the magnified drawing by their bell-shaped figure. They sometimes infest this species of larva to such a degree, as considerably to impede its motions in swimming. On each side of the abdomen, which commences near the origin of the first pair of branchia, or swimmers, arise the great vessels; the two are probably united near the tail, where an exceedingly curious process is also distinctly exhibited. The whole surface of the body is thickly covered with hairs, and several tufts are disposed in clusters, with some regularity, down the back and sides. The flexible pulsatory organ, in perpetual motion, is distinctly shown. Its form resembles the letter *S*, inverted. The use of the curious appendages at the lower extremity of the body, is unknown. Its tail is biforked and crustaceous. As the larva approaches maturity, it casts its skin several times, from each of which it escapes by a rent formed down the back.

THE RED VIPER. (*Coluber chersea*, LIN.)

Communicated by Hugh E. Strickland, Esq. to the Magazine of Natural History.

THERE is no department of the British fauna in which greater doubt and uncertainty exist than in the class of reptiles; and this is the more extraordinary, as our indigenous species are so very few in number. Thus, while in the class of insects we have careful and accurate lists and descriptions of upwards of 10,000 species, our native reptiles, although not more than twelve or

* The subject represented in the engraving was starved, in order to render its interior organization more clear: it may be observed that its intestinal canal is quite empty.

thirteen in number, have been so neglected, that even the best works on natural history contain many inaccurate statements respecting them. I send this paper, in the hope that it will aid in supplying the deficiency of our knowledge on this subject; not, indeed, with a view of communicating any new discovery, but of claiming a due degree of importance for an old one.

The red viper was distinguished from the common one (Coluber Berus, L.) by Linnæus, and described by him under the name of Coluber chersea. It was first noticed as a British species by Mr. Rackett, in the Linnæan Transactions, vol. xii., where he states that it occurred in Cranbourne Chase in Dorsetshire; and Mr. Sheppard, in the same work, has recorded his discovery of it in various parts of Suffolk. Since that time, however, Dr. Leach, in the Zoological Miscellany, has regarded this as a variety of the common viper; and Dr. Fleming has done the same in his excellent work on British Animals. I conclude, however, that neither of those authors can have seen the animal, as its characters are such as to remove all doubt of its being a distinct species. Two specimens were caught near Evesham in the summer of 1831, of which one was presented to the Zoological Society, and the other is now in my collection.

The most prominent distinction between the red and the common viper consists in their size; the former not exceeding 9 in. or 10 in. in length, while the latter often attains 3 feet. The length of my specimen is eight and three eights in., its largest circumference one and one tenth inch. It is of a bright ferruginous red, with zigzag markings down the back, resembling in form those of the common viper; but, instead of being black or dark brown, they are of a deep mahogany colour. It has also a series of irregular spots of the same colour along each side. The zigzag line terminates at the back of the head in a heart-shaped spot, placed between two converging dark-coloured bands, which meet on the top of the head, and again diverge towards the eyes. The head is much broader and shorter than in the common viper; but both species agree in the arrangement of the scales, having three scuta larger than the rest on the crown of the head, namely, one between the eyes, and two others immediately behind it. They have also a large scale over each eyebrow. The body of the red viper is more cylindrical than the common one, which is somewhat flat beneath. The belly, instead of being steel-coloured, is ferruginous, like the back.

Linnæus has correctly described this species in the Swedish Transactions, where he gives 9½ in. as the length. He states the abdominal scuta at 150; the caudal pairs at thirty-four. My specimen has 150 of the former, and thirty-two of the latter: it is, however, well known that these numbers are liable to vary in the serpent tribe. Among other characters, Linnæus notices a small dark speck on the tip of the tail, which is very distinct in my specimen. I have, however, observed this speck, though

less strongly marked, in the common viper. I may here add the authority of Cuvier in favour of this species being distinct. (See Le Regne Animal, vol. ii. p. 92.) It would seem, however, that he was unacquainted with our common English viper, and that his "vipere commune" is unknown in this country, as he classes the latter in a section of the genus Vipera, in which the head is uniformly covered with small granular scales; whereas the common viper of England agrees with the red viper in having three scuta larger than the rest on the top of the head; a character on which he forms another section.

The red viper is known to the inhabitants of Worcestershire under that name, and has the reputation of being very venomous. It is certainly a rare species, and I have never been able to procure any more than the above-mentioned specimen.

I have thus stated the claims of the red viper to be considered a distinct species. To facilitate the investigation of the subject, I have appended the references to different authors on the subject, distinguishing those which are copied from those which I have myself ascertained.

Vipera chersea.—Coluber chersea, "Lin. Act. Stockholm. 1749, pl. 6.;" "Fauna Suecica, p. 285.;" Syst. Nat. p. 377.; "Weigel. Abhand. der Hall. Naturf. vol. i. p. 12.;" Rackett, Lin. Trans. vol. xii. p. 349. Coluber Berus, "Laurenti Rept. p. 97. pl. 2. f. 1.;" "Daudin, Rept." Pelias Berus, "Merrem." Vipera Berus, "Fitzinger." Vipera chersea, Cuv. Reg. An. vol. ii. p. 92. Coluber Berus var. Fleming. Brit. An. p. 157.; "Leach, Zool. Mis. vol. iii."

ON THE BLACK PULP LEECH (*Planaria nigra*, MULLER,)

Observations on the Planariæ, by J. G. Dalzell, Esq. Advocate, F.S.A., Edinburgh.

THE following is quoted in the *Field Naturalist's Magazine*:

During the sunshine of summer, a small jet black velvet-skinned animal may be often seen crawling near the edge of fresh water ponds and ditches, with a lively, smooth, and gliding motion. This is the Black Pulp Leech, (*Planaria nigra*,) which has been already characterized and described by different naturalists; but, unfortunately for that accuracy which should mark the progress of science, their superficial observations concerning it have led to those numerous errors which darken the history of the whole genus.

Sometimes it is found in slow running waters, and there of the largest size; but usually when they are almost stagnant, and, in particular, where aquatic plants abound. On these, numbers crowd together as the colder season advances, each contracting into an elliptical spot, and then affording the most favourable opportunity for many being taken with faci-

lity at a time; or they fix on the under surfaces of pieces of slate and smooth stones, and somewhat elevated above the mud. They live in numerous pacific societies, associating with every other species, and are so generally dispersed, that none has occurred to me of such frequency in Scotland.

An animal so well known as the Pulp Leech, (*Planaria*) scarcely requires description: nor considering its external uniformity of appearance, does there seem much room for commentary. It is found of all different sizes, from extreme minuteness to above half an inch in length, and about an eighth of an inch in breadth. When very large, it has a dull and sluggish aspect, and is chiefly roused to action by light and heat. On the under part, or belly, are what naturalists have designated two ventral pores, one of which, perhaps both, is more conspicuous at certain seasons. The first is lower down than the middle of the body, and the second still nearer the extremity of the tail. The opacity of the animal precludes us from accurately distinguishing its internal organization; nevertheless, enough may be discovered to infer that it is far from simple. Among Pulp Leeches, (*Planaria,*) some occasionally occur of the ordinary size, figure, and proportions; but, instead of the jetty colour proper to the species, they are of a dark grey. By interposing them between the eye and concentrated rays of light, the internal structure may be obscurely recognised in many vessels branching from about the middle of the body, and terminating in obtuse extremities near the margin. These are certainly analogous to the pinnate ramifications already described; and they bear much resemblance to the viscera of leeches. Facts do not warrant our concluding, that the Grey Pulp Leeches, (*Planariæ,*) are indubitably a different species, or that they are only varieties; their contour seems more ovate, indeed, and they are seldom, if ever, seen of the largest size. One taken in October was of light grey, and mottled or streaked with deeper transverse bands; it was very broad in proportion to its length. Yet it must be admitted that repletion always affects the colour of the leading species, which regularly darkens according to the age and increment. Probably, from distension of vessels, shades of difference may prevail, which temporary causes render more prominent.

The Black Pulp Leech (*Planaria*) is endowed with wonderful tenacity of life, a property which materially aids the researches of the physiologist. This truth is forcibly demonstrated by the dreadful lacerations with which it appears in its natural element. Sometimes a large section from the neck is wanting, sometimes a semicircular wound almost divides the animal asunder, or one half of the body has been torn from the other, and still it survives the mutilation. This was a sufficient guide. The genus had been partitioned by nomenclators, according to the number of eyes, or their total absence; and a place from the latter was assigned to the Black Planaria. It was probable, however, if eyes were present, they should not be sought in the full grown animal, which might be of equal opacity to themselves; or, in other words, they would more easily be detected in regenerating parts: and, if such lacerations as I had witnessed did not destroy the animals, neither would artificial separation of important organs be fatal. Several planariæ were therefore decapitated on the 10th of September; and, in nearly three weeks, the wounds of some being examined by a magnifier, appeared not only completely healed, but a conical reproduction of the defective parts protruded. The regenerated organs of all animals are light and colourless; and I

thought that a row of minute marginal specks, such as are usually called eyes in the vermes and molluscæ, was discernible. This proved no illusion, for, on the 29th of the month, they were distinctly visible, of a jet black colour, seated in a pale ground. Other experiments corroborated the fact; whence, one characteristic of the species under discussion, is a row of numerous minute black specks or eyes, situate in the very margin of the anterior part. The same reserve in ascribing the faculty of vision to these specks, is as necessary in this instance as before; nor can we affirm, in denying them that peculiar province, that they are void of all analogy to spiracula, or organs connected with respiration. A subsequent examination of those planariæ just mentioned as a possible variety, showed that the head is sometimes so light as faintly to expose the sight of the specks. Thus, if the genus is to be partitioned according to the presence or absence of eyes, the Black Planaria will be removed from the place hitherto assigned to it.

In the course of my earlier observations on this animal, many unsuccessful experiments were made to discover its food, which seems chiefly derived from the under surface of aquatic plants in vigorous vegetation; and animal substances are likewise voraciously consumed.

The sexual union takes place with the black planaria, though rarely to be witnessed; nor had I completely conviction of the fact before August, 1812, notwithstanding preceding incidents had led to such an inference. Long anterior to that period, I knew that this species propagated by eggs, which, for the most part, are laid by those of larger size, and usually in the course of autumn; but they may occasionally be found throughout the year, or obtained in winter by the more genial temperature of an apartment. No external characteristic distinguishes the male and female planaria, if there be actually a difference of sex between them: that which is represented here, produced an egg, which entitles it at least to the character of female; and what I supposed the male, was probably not quite so large. The egg is imbued by a yellowish viscous matter, attaching it to any twig or straw selected for the deposit, or the side of the including vessel. It is of a perfect oval figure, of a dark-brown or chocolate colour, provided with a hard shell, and in every respect resembles a bird's egg in miniature. Those of the largest size, for great inequalities prevail, are about a tenth of an inch long; and one of this description is seen, somewhat magnified. I cannot confidently affirm that more than a single egg is produced by each planaria, but each egg contains several young, of the palest grey, or almost white: their anatomical structure is then best disclosed, as they speedily darken by succeeding increment. Some, hatched in the second week of September, were deep grey on the fourth of October. The speck or eyes may be recognised at an early stage by a magnifier, Fig. *c*, which also exposes slight discrepancies in shape between the young and the adult animal. A considerable interval elapses before exclusion of the young planaria; but observations on the period seldom coincide. By the most recent, four were detected in the very act of issuing from the egg, on the 11th of April, twenty-five days after it was laid: all lively, the marginal specks very distinct, but not of equal number. An egg of the same species was at the same time hatched in twenty-one days: but a fortnight later, a third of the like age was still entire. Therefore, the period required for exclusion, is to be calculated at twenty-one days, or longer; and it is certainly affected by the temperature of the atmosphere. The oviduct and relative organs appropriated for perpetuation of the species, are

most likely situated in the second ventral pore: neither this nor the first is conspicuous in all planaria; in many they are scarcely perceptible, and appear connected in some by a lighter line on the abdomen.

But, independent of propagating by eggs, the black planaria, from that indestructibility of life preserving it under mutilation, is privileged to multiply its species in proportion to the violence offered to its otherwise delicate frame. It may almost be called immortal under the edge of the knife. Innumerable sections of the body all become complete and perfect animals: if the head be cut off, a new one replaces it: if the tail be severed, a new tail is acquired: nay, if one half of the whole animal be longitudinally separated from the other, the defective portion is speedily repaired.

A grand and leading law of nature is invariably to fulfil her original object; whence we must conclude, that the performance of accidental lacerations, which we occasionally witness, results from some unknown condition opposing the progress of reproduction. In the artificial mutilations, where advances can be watched, the period of renewal is strictly commensurate with the temperature of the atmosphere. Regeneration is retarded, or altogether suspended, by the cold of winter, promoted by the heat of summer, and still farther accelerated by augmenting the natural warmth of the air. A number of planariæ mutilated on the 20th of January, 1803, had become entire animals in the succeeding April: but all the new parts were of a lighter colour, which was long in approaching the sable hue of the old: and it may be questioned whether they ever grow equally dark as those regularly deepened by age. Thus we see a black head, with a light coloured tail; a dark body, with a white head; and one longitudinal half as black as jet, while its corresponding portion is of a clear grey. The elementary parts of all animals seem colourless: their future opacity is derived only from certain assimilations of extraneous substances, the atmospheric influence, or supervening rigidity of the parts. Pellucidity marks the rudiments of life: fishes are transparent on exclusion from the egg; insects are pale on leaving the chrysalis; their organs are infirm and their senses obtuse. But scarce have they experienced the genial effects of the air, when their members expand, strength is acquired, and instinct becomes active; all as the universal shade of the body darkens. Yet exposure to the atmosphere, unmixed with another fluid, is inevitable destruction to the pulp leech (*planaria*). If, chancing to wander beyond the confines of its native element, its endeavours to return be interrupted, it contracts and grows distorted, a kind of gluten issues from the whole body, and death speedily ensues. Should it be hastily removed, it may recover, and then the gluten comes off like a sheath, or integument, investing the body; but the transition must be immediate. Whether this substance be provided by nature, to avert the baneful effects of unguarded exposure, or exudes in consequence of the sufferings of the animal, is uncertain.

In the natural state, the pulp leech (*planaria*) probably survives the cold of congelation; yet it perished during the course of an observation, where the thermometer stood at 26°, and where it was imbedded in a solid mass of ice. Perhaps the change was too sudden; for numerous societies dwell in shallow waters, affording an insecure retreat from the rigour of the atmosphere; nor are they diminished in succeeding seasons. The bodies of those which perish thus, are distorted, stiff, and invested by a very thick coating of gluten. In a few hours after solution of the ice, they become soft and relaxed, and are quickly decomposed.

SAGACITY OF BIRDS.

On June 4, a communication was read at the Linnæan Society from Thomas Andrew Knight, Esq., F.R.S. and L.S., President of the Horticultural Society, giving an account of two remarkable examples of sagacity displayed by Birds during the period of incubation. The most remarkable of these was as follows:—A wild duck had deposited her eggs near the side of a brook, but so far above the highest level to which the water had ever been known to rise, as to be apparently perfectly secure from being overflowed. An exceedingly violent thunder-storm, however, caused the brook suddenly to rise far above its usual level; the nest was in consequence overflowed, and the eggs remained submerged during more than two hours. No expectations were entertained that the bird would ever return to the nest, or that life had not been totally extinguished in the eggs: but she did return to the nest, and every egg hatched well. The water which had covered the eggs was very warm, and the temperature of the nest and the eggs, after the water had subsided, probably led the animal, Mr. Knight conceives, to resume her labours, which he is of opinion she would not have done if a lower temperature and longer immersion in the water had extinguished life in the eggs, and of course rendered such labour abortive.

ZOOLOGICAL SOCIETY.

Notes, abridged from the Proceedings of the Committee of Science and Correspondence.

IBIS.—DUCK.

September 25, and October 9, 1832.—Colonel Sykes's exhibition of the collection of *Birds* formed by him in Dukhun. *Ibis religiosa*, Cuv., Regne Anim. 1. 483. *Sacred Ibis*. *L' Ibis sacre*, Cuv., Recherches sur les Ossemens Fossiles, 1. 161. *Tantalus Æthiopicus*. *Ibis Macei*, Cuv., Ann. Mus. 11. 125. *White Ibis with purple black secondary quill decomposed feathers*, Ind. Orn. 2. 706.

Col. Sykes carefully compared the descriptions and measurements of the larger *Mummy Ibis* of Cuvier; and is induced to believe the present bird is the same. Col. Sykes puts into juxtaposition the measurements of Cuvier's *Mummy Ibis* from Thebes and one of his own birds:—

	Mummy Ibis. Inches.	*Dukhun Ibis.* Inches.
Length of beak and head together	8·27	8·15
Head	1·85	1·80
Tibia	5·90	5·80
Tarsus	4·01	3·80
Middle toe	3·81	3·50
Ulna	6·01	5·95
Hand	4·92	4·80

The individual of which the measurements are given has the two first quills tipped with violet, their shafts of the same colour, and four of the secondary quills are also violet and with their webs decomposed, accord-

ing with Cuvier's description. The violet colour is not so deep as in the *Æthiopian Ibis ;* but as in all Col. Sykes's specimens (nine in number) the violet feathers are in progress of developement, the colour would no doubt subsequently be darker. Cuvier mentions that the *Mummy Ibis* varied a little in size. Col. Sykes has birds larger and smaller than that of which the measurements are given.

Appear in Dukhun in the cold weather only. Gregarious.

Irides narrow, lake colour. Food, water-crickets, crabs, beetles, shrimps. Length, inclusive of tail, thirty to thirty-five and a half inches ; tail, five and three-tenths to five and seven-tenths inches ; bill and head to occiput seven and eight-tenths to nine and six-tenths inches ; bill to the gape, six and four-tenths to seven and eight-tenths inches.

Ibis ignea. Tantalus igneus, Lath., Ind. Orn. 2. 708. 12. *Ibis falcinellus*, Temm., Man. d'Orn., 2nd Edit. 2. 596.

Col. Sykes's birds, male and female, are identical with two European specimens in the British Museum, labelled *Ibis ignea*, and viewed as the immature birds of *Ibis falcinellus*. Col. Sykes, however, has seen so many of both in India, appearing in different flocks at the same period of the year, and not having, as M. Temminck describes the birds before they are three years old, "partie inferieure du cou, poitrine, ventre, et cuisses d'un noir cendré ; haut du dos et scapulaires d'un cendré brun," but of a rich fuscous brown, with brilliant metallic reflections ; differing also in the proportions of the internal organization ; and Dr. Latham moreover describes even the youngest birds of *Ibis falcinellus* as characterized by reddish brown. Herodotus speaks of the *smaller Ibis* as entirely black, a description inapplicable to the *Ibis falcinellus*, but applicable to the present species, which at a short distance appears entirely black. Col. Sykes is, therefore, induced to adopt the opinion of those writers who considered the bird distinct from *Ibis falcinellus*. Its measurements correspond with those of the smaller species of *Mummy Ibis* given by Cuvier ; and it agrees in plumage (intense blackish brown with metallic reflections, without any mention of chestnut or marone, the livery of the *Ibis ignea*,) with the descriptions of the ancients ; it is, therefore, very probable, as M. Temminck suggests, that it is the sacred species worshipped and embalmed by the Egyptians.

Length, (male), inclusive of tail, twenty-five and a half inches ; tail, four and a quarter inches. Female, twenty-three and a half inches ; tail, four inches.

Black beetles, *larvæ* of water insects, and numerous univalve shells found in the stomachs of these birds.

Ibis falcinellus, Temm., Man. d'Orn. 2nd Edit. 2. 599. *Tantalus falcinellus*, Linn., 1. 241. Gmel. 1. 648. *Le Courlis verd*, Buff., Ois. 8. 29. *Courly d'Italie*, Buff., Pl. Enl. 819. *Marone Ibis.*

Sexes do not differ in plumage ; but the female is somewhat smaller than the male.

Length, inclusive of tail, twenty-six to twenty-six and a half-inches ; tail, four and a half inches. Multitudes of black beetles and grasshoppers, and univalve fresh-water shells, found in the stomach. An *immature* bird in possession of the Zoological Society, unlike the supposed immature bird, (*Ibis ignea*), is characterized by the marone livery of the *Ibis falcinellus*.

Plotus melanogaster, Gmel. 1. 580. *Anhinga noir du Senegal*, Buff., Ois. 8. 453. Pl. Enl. 960 and 107. *Black-billed Darter*, called the *Snake-bird* in Dukhun.

Irides bright yellow. Length, inclusive of tail, thirty-seven and a half inches; tail, nine and a half inches. Solitary. Rare in Dukhun, but frequently met with below the Ghauts. This bird has the singular faculty of being enabled to swim with the whole of its body under water, the long neck and head alone being visible, looking like a snake. Colonel Sykes's limits do not permit him to enlarge on the very peculiar formation of the stomach, more resembling that of a ruminant than a bird. Seven small carp and much deep-green vegetable fibre were found in the stomach of a female.

Colonel Sykes states, that the *domestic Duck* (*Anas Boschas*) is extensively bred by the Portuguese in Western India, and that it is subject to a kind of apoplexy, which carries it off in a few minutes, although previously in apparent health. He has known a trader lose a flock of more than thirty in the course of one day; and he has himself had ten ducks struck simultaneously, stagger about for a short time as if drunk, run round in circles, fall on their backs, and die. He has not been able to discover any morbid appearances in the brain. In no instance, in the stomachs of the *Anatidæ*, were animal matters met with; the contents consisted of grains, seeds, vegetables, and gravel.

NEW MAMMALIA.

On April 9, an extract was read from a letter, addressed to the Secretary by Charles Telfair, Esq., Corr. Memb. Z. S., and refering to a Viverridous animal obtained by that gentleman from Madagascar, which lived for several months in his possession, and on its death was transmitted in spirit to the Society. Mr. Telfair states his belief that the animal is new to science; a belief in which Mr. Bennet participated, and stating his impression that the animal should be regarded as the type of a new genus, nearly allied to, but distinct from, *Paradoxurus*, he proposed for it the name of *Cryptoprocta ferox*.

Mr. Ogilby called the attention of the Society to a specimen of a mammiferous quadruped, communicated by Mr. Steedman for exhibition which he described in detail with reference to a paper "On the Characters and Description of a new Genus of *Carnivora*, called *Cynictis*." The new genus proposed by Mr. Ogilby connects the family of the *Civets* with that of the *Dogs*, participating with the one in its organs of mastication, and with the other in those of locomotion, and consequently ranging with *Proteles*, Isid. Geoff., as a second genus, intermediate between those two groups. *Proteles*, however, partakes in some degree of the characters of the *Hyænas*, while *Cynictis* is more immediately interposed between the *Dogs* and *Ichneumons*, to the latter of which it bears a pretty close resemblance in external form.

The general colour, as well as the whole external appearance of the animal, is that of a small *Fox*.

Mr. Ogilby described in detail the generic and specific peculiarities, and pointed them out on the preserved skin and on the *cranium*; in the latter, as in that of *Herpestes*, the bony ring surrounding the orbit is complete. He added also references to the Travels of Sparrman, for a notice apparently of this animal; and to those of Mr. Barrow, (vol. i. p. 185,) in which a brief, but perfectly intelligible account of it is contained: it is there said to be "known to the colonists under the general name of *Meerkat*." Mr. Steedman's specimen was obtained in the neighbourhood of Uitenhage, on the borders of Caffraria.

NEW BIRDS.

On May 14.—A paper was read by Mr. Gould "On a new Genus of the Family *Corvidæ*." The genus proposed by Mr. Gould comprehends the *Pica vagabunda*, Wagl., *Pica Sinensis*, Gray, and a third species which the author believes to have been hitherto unnoticed. To this group, on account of its arboreal habits, he gives the name of *Dendrocitta*, applying the specific name of *leucogastra* to the new species, which he regards as the type of the genus. The shortness and comparative feebleness of the *tarsi* in *Dendrocitta*, and its more elongated tail, the feathers of which are equally graduated, except the two middle ones which are much longer than the others, distinguish it from the typical *Piscæ*, the *common Magpie* for example. These characters are in accordance with its habit of wandering from tree to tree in search of its food. It is further distinguished by the form of its bill. All the species yet known are natives of Eastern Asia.

NEW MAMMALIA.

On May 14.—Mr. Bennett called the attention of the Society to the skin and skeleton of an animal recently living in the Menagerie, and exhibited in illustration of a paper "On the Family of *Chinchillidæ*, and on a New Genus referrible to it," the commencement of which he read. The animal in question was purchased, in June 1832, from a dealer, who was completely ignorant of the locality from which it was originally obtained; and was brought by Mr. Bennett under the notice of the Committee of Science and Correspondence at its first meeting in that month. He then stated his conviction that it would be found to constitute the type of a new genus, intimately related to *Lagostomus* and *Chinchilla*, which he proposed to designate by the name of *Lagotis*, adding the specific denomination of *Cuvieri*, in commemoration of the illustrious naturalist, whose irreparable loss the world of science was just then called upon to deplore. He deferred, however, the completion of his account of the animal, until he should be enabled, at its death, to add the dentary and other internal characters, to the more obvious external distinctions on which he then relied. That opportunity having now occurred, he proceeded on the present occasion to redeem his pledge, and also to take a general view of the history, zoological characters and anatomy of the family to which it manifestly belongs.

As regards the history of *Lagotis*, although the last of the three animals, constituting the family to come under the cognizance of zoological science, Mr. Bennett stated that he had little doubt that it was in fact the earliest known to travellers in South America, which he had no hesitation in assigning as its native country. He believed it to be the *Viscachà* of all the writers from Pedro de Cieça downwards, (including Acosta, Garcilasso, De Laet, Nieremberg, Feuillee, Ulloa, Vidaure, Molina, Schmidtmeyer and Stevenson,) who have mentioned that animal as an inhabitant of the Western or Peruvian acclivities of the Andes. The *Lagostomus*, on the other hand, is clearly the *Vischaca* described by so many travellers as colonizing the vast plains eastward of that great chain. Among these he cited Dobrizhoffer, Jolis, D'Azara, Proctor, Head, Miers and Haigh. For its zoological history he referred to its various describers, from M. De Blainville to M. Lesson. To complete the history of *Chinchilla* he also gave an account of the various notices regarding it, which have appeared since September 1829, the date of his account of it in the "Gardens and Menagerie of the Zoological Society."

In the *Lagotis Cuvieri* the fore feet, like the hinder, have only four toes, there being no vestige of a thumb; and the claws are small, slightly sharpened, and entirely concealed by long and somewhat bristly hairs. Those of the hinder feet are similar in shape and rather larger; but that of the inner toe is flattened, curved inwards, and exposed, the hairs immediately adjoining it giving place to a tuft of about eight rows of short, stiff, horny, curved bristles, approaching nearly in their rigidity to the comb like appendage, which is found in almost the same situation in the *Ctenodactylus Masonii*, Gray. A similar structure also occurs in the *Chinchilla*.

Mr. Bennett afterwards entered at length into the internal anatomy of *Lagotis* and *Chinchilla*, and gave a full description of their skeletons, dwelling more particularly on the points of difference existing between them. He concluded by some observations on the tribe of *Rodentia* to which these animals are referrible, and on the genera which compose it.

BLACK LEMUR.

On June 11, a specimen was exhibited of the *black Lemur*, *Lemur niger*, Geoff., which had recently been added to the Society's Menagerie. In calling the attention of the Society to it, Mr. Bennett stated his belief that this was the first individual of the species which had fallen under the observation of zoologists since the days of Edwards, its original describer, who saw and figured one which was living in 1755 in the possession of a surgeon in London. The description and figure given by Edwards have consequently been hitherto the only proofs of the existence of such an animal. Mr. Bennett added that the *black Lemur* is the type of the *Lemur Macaco*, Linn.; and that the *Vari*, to which the name of *Lem. Macaco*, has been applied by modern authors, is given by Linnæus as the Var. d. of that species. Custom having, however, transferred the specific name to the variety, he deemed it better to acquiesce in the use which has obtained, leaving to the *Vari* the name of *Lem. Macaco*, and to the *black Lemur* that of *Lem. niger*.

NEW FELIS.

On the same day specimens were exhibited of a species of *Felis*, of a size intermediate between the larger and the smaller animals of that genus, and having in its grey colour and longitudinal striping a general external resemblance to some of the *Viverræ*. This Mr. Bennett regarded as new to science, and proposed to designate it

FELIS VIVERRINUS. *Fel. fulvo-cinereus, subtùs albescens; capite, nuchâ, dorso, genis, gulâque nigro vittatis; lateribus, ventere, pedibusque nigro maculatis.*

Long. *corporis* cum capite, 33 unc.; *caudæ* mutilæ, 7; *auriculæ*, 1½.

The prevailing colour of the upper surface is a rather deep yellowish grey, the separate hairs being dusky at the base, yellowish in the middle, and having short black tips. The black lines and spots are formed of hairs destitute of yellow, and having the black tips of much greater length. A longitudinal black band passes on each side, from the inner *canthus* of the eye above the ear nearly to the shoulder; a second, more internally, passes to the same distance backwards, and is somewhat interrupted anteriorly; and between this and its fellow on the *vertex* is the vestige of a median line, which on the forehead is broken up into a double row of spots; these and the two adjoining lines subdivide in front into numerous very small spots between the eyes. Two black lines pass downwards obliquely on either side from below the eye, over the angle of

the jaw; and from their terminations on each side there passes a transverse band across the throat: the space between these lines is nearly white, as is also a stripe over each eye, and the whole of the under jaw and chin. There is a large black spot surrounding the base of the ear posteriorly, and the ear is also tipped with black. The long, linear markings of the back are disposed in about five interrupted, longitudinal bands, and some of the spots on the sides assume a linear form. Of these the most remarkable are, one on each side of the neck, and an oblique wavy band on the shoulder. The spots on the sides generally approach a rounded shape, and form, posteriorly, four or five interrupted longitudinal rows. Those of the under surface are larger, and are arranged without order. On the fore limbs the spots are small externally, and internally there are on each two large transverse black patches. On the hinder limbs the spots are arranged so as to form interrupted transverse bands on both surfaces. The hairs of the soles of the feet are dusky brown. The tail is spotted above in the same manner as the sides; its colour beneath is uniform. The spots are throughout numerous. The whiskers are white, and take their origin from three black lines on either side.

The species is nearly allied to *Felis Serval*, Schreb., but will readily be distinguished by the characters above given, by the comparative shortness and strength of its limbs, and by the locality whence it was obtained.

THE HYÆNA.

On the same day, Col. Sykes reminded the Society that, in submitting his Catalogue of the *Mammalia* observed in Dukhun, East Indies, he took occasion to comment on the popular error respecting the ferocious and untameable disposition of the *common Hyæna*, *Hyæna vulgaris*, Cuv. His opinions were founded partly on observation of a cub which he had domesticated, and partly on facts communicated by his friends. He went on to state as follows:

"Two years have elapsed since I placed in the Gardens of the Society the above-mentioned cub (a female), which has now attained its full growth, and I am happy to be enabled to confirm the opinions I formerly advanced. In India it was allowed to run about my house, and on board ship it was released from its cage two or three times a day, to play with the sailors and gambol with the dogs. It early recognised my person and voice, and would obey when called: and in general was as playful and good-humoured as a puppy. My visits to it in the Gardens have been rare, and at long intervals, nor have I ever carried it food; I anticipated, therefore, that it would outgrow its early associations, and that I should be to it as any other stranger; but it has always greeted me not only as an acquaintance, but as an old friend; and if I am to judge from its agitation and peculiar cries, the animal's recognition is that of affection.

"On Sunday last it was asleep in its cage when I approached. On calling to it by its name it looked up, distinguished me in the crowd, started on its legs, and on my applying my hand to its mouth to smell to, threw itself down against the bars, rubbed its head, neck, and back against my hand, and then started on its legs and bounded about its cage, uttering short cries. On ceasing to speak to it, and moving away, it stopped and looked wistfully after me, nor resumed its motions until I addressed it again. Its manifestations of joy were so unequivocal, as to excite the surprise of a great number of bystanders. As these pleasing

traits in the disposition of a calumniated animal appeared so new to those who surrounded me on that occasion, they may possibly be deemed of sufficient interest to be worthy of extended promulgation by record in our Proceedings.

"I take occasion to repeat my conviction, that association with man, constant kindness, and abundance of food, will suffice not only to modify, and indeed eradicate, the worst traits in the disposition of any animal of the higher classes, but give birth to others of which their natures were not deemed susceptible."

EPIGLOTTIS OF BIRDS.

On June 25, Mr. F. D. Bennett exhibited a dried preparation of the upper *larynx* and adjoining parts of the *Albatros, Diomeda exulans*, Linn., for the purpose of demonstrating the existence in that bird of an *epiglottis*. Having demonstrated this and the adjacent parts on the preparation exhibited by him, Mr. F. D. Bennett added that as it had been the opinion of naturalists in all ages that no bird possesses an *epiglottis*, the structure which he had brought under the notice of the Society appeared to him highly interesting. So fixed was the opinion to which he had adverted, that when Warren showed the existence in the *Ostrich, Struthio Camelus*, Linn., of a structure which he regarded as an *epiglottis*, the denomination was generally rejected even in this anomalous bird, and the part was considered as a mere elevation at the base of the tongue, a rudiment, but without the function, of the organ. In the *Albatros*, however, the function is that of an *epiglottis ;* and the size, though small, is sufficient for the protection of that portion of the *rima glottidis* which cannot be closed in the manner usual in birds by the apposition of its margins. With a peculiar structure of the *glottis* there exists an apparatus equally peculiar in the class, as a provision against the inconvenience which might otherwise result from the deviation from the normal structure.

LIGHT OF THE SEA.

On the same day, Mr. F. D. Bennett also exhibited several specimens of a species of *Pyrosoma* captured by him, on the 6th of September, 1832, at sea, in lat. 1° 41′ N., long. 11° 56′ W. Between 2 and 4 A.M. the sea having been two hours before less luminous than usual, presented one mass of bright phosphoric light extending to a considerable distance around the vessel. The extensive field of bright luminous matter emitted so powerful a light as to illumine the sails, and to permit a book of small print to be read with facility near the windows of the stern cabins. Above this luminous field numerous sea fowl were hovering in search of their prey. The light appeared to be entirely owing to the *Pyrosomata*.

Specimens taken from the sea and placed in a vessel containing sea water, ceased altogether to emit light, or emitted it but sparingly while they remained at rest. On the water, however, being agitated, or when one of the masses of animals was taken into the hand, the whole mass became instantly illuminated by myriads of bright dots, much resembling in hue the points on the *elytra* of a diamond beetle, *Curculio imperialis*, Fab.

The *Pyrosoma*, thus enveloped throughout its whole extent in a flame of bright phosphorescent light gleaming with its peculiar hue, presented a most splendid spectacle, the light shed by it was sufficient to render objects distinctly visible in every part of an otherwise dark room. If long retained in the hand, or returned to a quiescent state in the water, the

luminous spots gradually faded, and no light was visible until the animal was again disturbed, when the illumination instantly returned with all its vivid splendour. After death it emitted no light.

The mass of *Pyrosoma*, of the usual cylindrical form and gelatinous substance, was about 4 inches in length and 1½ in circumference. The tube, passing along its middle, is described as being open at both ends; the orifice at the broader extremity being much better defined in its circular form, larger, and more distinct than that of the opposite end. The surface of the mass appeared to be studded with numerous prominent rigid and pearly tubercles intermingled with small specks of a brown or red colour. In these latter the power of emitting light appeared chiefly to be seated, these being frequently bright while the remainder of the body exhibited only its natural white or yellowish white hue; a hue which changed after death into a red tinge. The brown specks, when removed from the body, did not emit light.

On July 23,—Colonel Sykes exhibited several specimens of *Loligo sagittata*, var. β, Lam., which came on board the Lady Feversham on his passage to England in 1831. He read the following extracts respecting them from his journal.

"Monday, April 3, 1831.—Lat. 22° 20′ S., long. 1° 52′ E.—Three specimens of *Loligo sagittata* leaped on board at sun-set on the forecastle, which the men saw, the trade wind being so light at the time as to threaten a calm.

"Two days afterwards, in lat. 18° 6′ S., long. 3° 12′ W., several other individuals of the same species were found at daylight on the poop, having come on board during the night, the wind having been steady and the sea smooth."

Col. Sykes stated his object in bringing the specimens under the notice of the Society, was to point out the locality from which they were obtained, the habitats given by Lamarck being the European and American seas; and to direct particular attention to the leaping powers of the animal, which he believed to be hitherto unobserved. He added that he was unable to satisfy himself as to the organization by which it was enabled to throw itself above the surface of the sea.

Mr. Owen mentioned as an additional instance of the existence of this power in the *Loligo sagittata*, that two specimens were preserved in the Museum of the Royal College of Surgeons, to which they were presented by Dr. Henderson as having leaped on board a vessel in the Mediterranean.

THE SLOTH.

On Aug. 13, Mr. Bell read a paper, entitled "Observations on the Neck of the *three-toed Sloth*, *Bradypus tridactylus*, Linn., demonstrating that this animal possesses only the Normal Number of Cervical *Vertebræ*."

ADDITION TO THE MENAGERIE.

On September 10, the Secretary called the attention of the Society to several recent acquisitions to the menagerie; including a specimen of the red-handed tamarin monkey, *midas rufimanus*, Geoff., presented by J. Christopher, Esq.; of the created porcupine, *hystrix cristata*, Linn., which had recently been brought forth there, being the first instance of such an occurrence in this species, and respecting which he added, that observation of the young while sucking confirmed the correctness of

M. Blumenbach's statement that the nipple is nearly axillary; of the purple-crested touraco, *corythaix porphyreolopha*, Vig., presented by J. J. Audubon, Esq.; and of the *platycercus novæ Hollandiæ*, Vig., *psittacus novæ Hollandiæ*, Lath., a species which appears not to have been seen since the time when it was originally described until very recently, when a living specimen for the menagerie, and skins for the museum, were obtained nearly simultaneously. Mr. Bennett also called the attention of the meeting to a living *lemur*, forming part of the Society's collection, and pointed out the distinguishing marks which induced him to consider it as the representative of an undescribed species, for which he proposed the name of *lemur rufifrons*.

On the same day Mr. Gould exhibited specimens of the male and female of the *trogon pavoninus*, Spix: the latter, he stated, has hitherto escaped the observation of ornithologists. It has recently been acquired for the Society's collection. The female rather exceeds the male in all her proportions. Her bill is black instead of yellow; her crest is shorter, and has bronzy reflections. The whole of the under surface is of a brownish grey, with the exception of the under tail coverts, which are scarlet. The outer tail feathers, which in the male are white with black shafts, are in the female barred, except at the base, where they are dull black. The colours of the upper surface are similar in both sexes; but the plumes which spring from the rump, and which in the male attain so remarkable a length, scarcely extend in the female beyond the tip of the tail.

INDIAN PARTRIDGE.

A "Description of *Perdix Lerwa*," by B. H. Hodgson, Esq., Corr. Memb. Z. S., was read. It was accompanied by a coloured drawing of the bird, which inhabits the northern region of Nepâl, and forms, by its half-plumed *tarsi*, a sort of link between the partridges and the grouse. Its habits assimilate with those of the latter genus. It is found close to the permanent snows, among rocks and low brushwood, and sustains itself upon aromatic buds, leaves, and small insects. It is characterized as *Perdix Lerwa*.

The great comparative expanse of the wing; the diminution of its rounded form by the second quill feather being the longest; the increased length and strength of the tail; and the extent of the feathering of the *tarsi*, are very remarkable characters, which give to this species a peculiar interest.

THE CHEETAH.

On the same day a paper "On the Anatomy of the *Cheetah, Felis jubata*, Schreb.," was read by Mr. Owen. It commenced by remarking on *Felis* as a truly natural genus, and by observing that the anatomical structure of the animals composing it offers even fewer differences than their outward forms. The principal deviation from the common type is that which obtains in the organs of voice of the lion (and, as Mr. Martin has observed, in those of the jaguar also), where the *larynx* is situated at a considerable distance from the posterior margin of the bony palate, the soft palate and the tongue being proportionally increased in length, and thus a gradually expanding passage is formed, which leads from the *glottis*, where the air is rendered sonorous, to the mouth. This structure may contribute, in the lion, to produce the peculiar roar of that animal.

In the cats generally, the connexion of the *os hyoides* to the *cranium*

is not by a long elastic ligament, as in the lion, but by an uninterrupted series of bones. This latter structure exists in the cheetah. The cheetah has also the circular pupil of the lion, tiger, leopard, and jaguar, and is perhaps the most diurnal of the genus.

In the form of the *œsophagus*, and in the transverse *rugæ* of its lower half, the cheetah agrees with the lion; and, as in it and in the other *feles*, the *œsophagus* is not prolonged into the *abdomen*, but terminates immediately after passing through the diaphragm in the stomach. This organ in the cheetah has all the peculiarities which are found in the genus *felis*. The intestines also agree in character with those of that group; and the *cæcum*, as usual in it, is simple, having none of the convolution which is found in the dog. The liver, *pancreas*, and spleen, resemble those of the cats generally; as do also the kidneys in the arborescent form of their superficial veins: a form, however, equally common to the *viverridæ* and the *felidæ*, which also agree in having *spiculæ* on the tongue.

The *viscera* of the *thorax* in the cheetah agree with those of the cats. The *lytta*, or rudiment of the lingual bone, so conspicuous in the dog, is reduced in it, as in the other feline animals, to a small vestige.

The elastic ligaments of the ungual *phalanges* exist in the same number and position as those of the lion; they are, however, longer and more slender, their length alone occasioning the incomplete retraction of the claws as compared with the rest of the *felidæ*. Mr. Owen concluded by observing that in the circulating, respiratory, digestive, and generative systems, the cheetah conforms to the typical structure of the genus *felis*.

SOUTH AMERICAN BEAR.

On October 22, a letter was read, addressed to the Secretary by Sir R. Ker Porter, Corr. Memb. Z. S., and dated city of Caracas, August 14, 1833. It described a bear now living at that place and brought from the Andes, which differs in the marking of its face both from the individual of *ursus ornatus*, figured by M. F. Cuvier, and from that which forms at present a part of the Society's menagerie. The yellowish white of its face begins on the bridge of the nose between the eyes, and describes under each eye a semicircle, whence it extends over the whole of the muzzle, taking rather a greyish hue, until it ends in pure white, covering the whole throat and chest, and forming a point between the fore legs. The rest of the animal is jet black, the hair being silky and shining. It is smaller by far in size than the bears of the northern countries of Europe, and is more compact in form.

BOTANY.

NOTES ON MILDEW.

*From a Lecture on that subject by Professor Lindley, delivered at the Horticultural Society's Meeting Room.**

EVERY horticulturist has heard of mildew; and, though it is often confounded with blight, honey-dew, &c., the destructive fungi which constitute the real mildew, and the ravages they occasion, are unfortunately but too familiar to every one accustomed to either a garden or a field. Notwithstanding this, even the most eminent horticulturists know comparatively little either of the nature of this pest, or of its cure. One most important error exists respecting it, and this is, the belief, common among gardeners and agriculturists, that one kind of mildew will infect several kinds of plants: but this can never be the case; each tribe of plants has a mildew peculiar to itself, which cannot, under any circumstances, affect plants of a different kind.

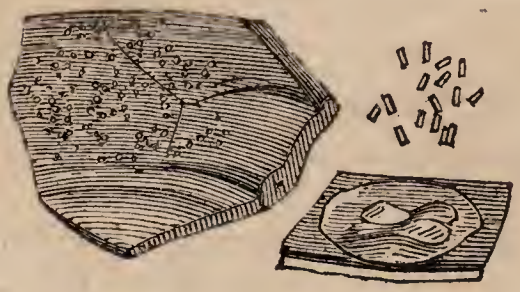
Mildew generally appears on the leaves or stems of plants in the form of red, white, or black spots, as a number of minute projections, as a frosty incrustation, or as a brownish powder; in every case spreading, more or less rapidly, according to its kind, and in its progress withering the leaves, destroying the fruit, and, finally, killing the plant. The popular reasons assigned for this pest are various: it has been ascribed to insects, fog, and even, in one agricultural report, to the inflammation of the oxygen gas in the air towards the end of summer, which scorched the leaves. These opinions have, however, been all proved to be erroneous. Mildew is nothing more than different kinds of fungi, or parasites, attacking different kinds of plants, and varying in appearance and species according to the nature of the plants which they attack. It is the greatest enemy to the agriculturist, but the gardener also suffers from it severely.

The fungi, commonly called mildew, are divided into three classes:—1. Those which grow, or rather lie, on the surface of leaves, and which, perhaps, do not derive any nutriment from the plant; 2. Those which are formed in the interior of the stem or leaf, and protrude themselves from it when ripe; and, 3. Those which only attack the roots. All are extremely simple in their

* Abridged from the Gardener's Magazine.

organization, and very minute in their forms; they seldom appear but in autumn, except in forcing-houses.

The first class, or mildew composed of those fungi that live on the surface of leaves, injure a plant by preventing its respiration, but do not appear to draw any nourishment from it. One of the most common of the fungi which attack the common cabbage is Cylindrosporium concentricum, *Grev.* These very destructive fungi have the appearance of small white patches, or specks, of frosty incrustation, which, when magnified, are found to consist of a number of small cylinders, lying end to end, or across each other. These cylinders are all filled with seed, and burst when it is ripe, scattering it in every direction: wherever it falls upon the leaf it takes root, and thus the fungus spreads rapidly.



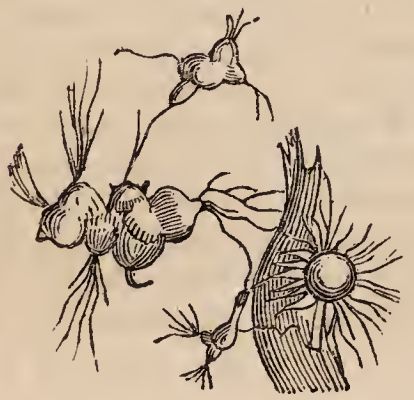
The second class of fungi, viz. those which spring from the interior of leaves and stems, are by far the most fatal. These fungi generally appear in a sort of bag or case, which is supposed to be formed of the cuticle of the affected leaf. The oak is attacked by a species of fungus, Æcidium, different varieties of which are found on many kinds of forest trees. The Æcidium Pini found on pine trees, has, when magnified, the appearance of a number of nine-pins. When ripe, the cuticle which covers the fungus bursts, and emits a powder of a bright orange colour, which is the seed. A mildew of this kind, which infects corn, is highly injurious to the farmer. It is vulgarly called the pepper brand; and, when corn is attacked by it, it gradually consumes the substance of the grain, leaving in its stead only a dark powder, which has a very offensive smell. This fungus is found only on barley, and in this respect differs from the Uredo Segetum, or smut, which is destructive not only of barley, but also of wheat and oats. The Uredo Segetum, or smut, has been the subject of many interesting experiments by Mr. Bauer, of Kew, whose discoveries will no doubt throw very considerable light upon the subject. It not only destroys the grain, which it converts into a kind of jelly, but it attacks the leaves and stems, always forming in the interior of the plant, and bursting forth when ripe.

It is a vulgar error to suppose that a berberry tree (*Berberis* vulgaris, *L.*), if planted in a corn field, will, if infected with mildew, communicate the disease to the corn. This cannot be the case, as the mildew which attacks the berberry (Æcidium *Berberidis*, Pers.,) is quite different from any of the fungi which are found on corn. The berberry mildew, when magnified, is found to consist of a number of small orange cups with white

films over each. When ripe, these lids burst, and the top of the cup assumes a ragged uneven appearance, like white fungi. Each cup has within it a number of little boxes containing seeds.

The ergot on the rye is a well-known and very destructive species of mildew. It partakes of the nature of the truffle, and grows out of a spike of corn like a prolonged kernel. It is long, horny, and cartilaginous; and it consists of fibres closely interlaced. This disease evidently originates in the centre of the stem. It affects maize, various species of grass, and is often found in plants of yellow gentian, &c.

The principal fungi of the third class, or those which attack the roots of plants, are two; and both closely resemble truffles.



One of these (Rhizoctonia Crocorum) which is of a brownish yellow, attacks crocuses; and, in those countries where the crocus is cultivated for its saffron as an article of commerce, it makes great ravages. It is called by the French *la mort du safran*, and soon destroys a whole crop. The other fungus, Periola tomentosa, is found on the potato, lucern, &c. It turns the roots, which are naturally white, of a purplish hue. Its ravages are often attributed to grubs. Both these fungi appear to be propagated by spawn, or fibres which spread through the earth, and cling round the roots which they find in their way.

All these kinds of fungi are very easily propagated, from the

rapidity with which they arrive at maturity, and the immense number of seeds which they produce. Most of the mildew fungi require only twenty-four hours from the first springing of the plant to the ripening of its seed; and the number produced by each may be guessed from the circumstance of one mushroom being sufficient to propagate 250,000,000. The extreme minuteness of the mildew fungi renders them still more numerous. The first class, or the superficial mildew, appears to be communicated by the air, the seeds when ripe being carried by it from one plant to another, and establishing themselves wherever they touch. They destroy a plant by covering the surface of its leaves, and thus preventing respiration. Plants are generally most affected by superficial fungi after a long drought, when the fibres of their roots are unable to imbibe sufficient moisture from the soil, and the plant thus becomes debilitated, and affords an easy prey to the parasite which attacks it: as a proof, Dr. Lindley mentioned that in Scotland, where there are heavy night dews, this fungus is unknown. The cure seems to be abundant watering.

The internal mildew evidently cannot be communicated by the air, since it always appears to spring from the interior of the plant, and to be at first covered with a thin skin, from which it does not burst till it is ripe. It is impossible, therefore, that this kind of mildew can be communicated externally, and yet the fact that it is contagious is so clear as not to admit a doubt. The only manner in which it appears probable that it can reach the interior is through the roots. The seeds, when ripe, fall upon the earth, which becomes contaminated by them, and they are sucked up by the spongioles of the roots.

Red plants are said to be more liable to mildew than any other. Red is, indeed, supposed by some, always to indicate a morbid action, as it shows that the plant is unable to absorb carbonic acid gas from the atmosphere, which is necessary to its perfect health; at all events, it is a proof of disease when leaves, or any other parts of a plant, not naturally red, assume that colour. Other experiments have been made for curing, or at least preventing the spread of, the internal mildew; and Mr. Bauer has found that steeping grains of corn in lime-water will produce the desired effect. There appears no cure for mildew in the roots, but by cutting a deep trench round the infected plants, and cutting off all communication between them and the rest of the field.

ON THE LEAF PULP OF PLANTS.

By M. Adolphe Brongniart.

THERE exists beneath the rind (*cuticle*) of the leaves of plants two or three layers of oblong blunt vesicles, placed perpendicular to the surface of the leaf, and generally much less in diameter than the cells of the rind, so that they are easily seen through it.

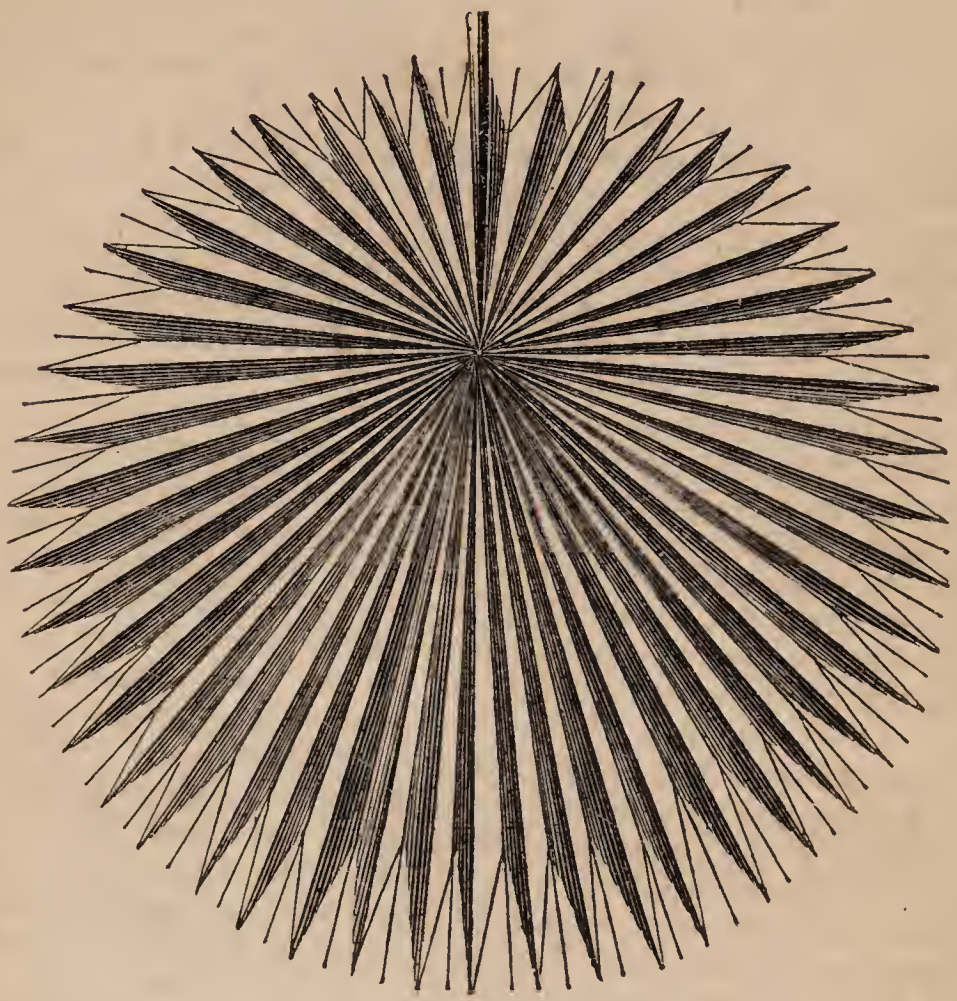
These vesicles, which appear specially destined to give solidity to the pulp (*parenchyma*) of the leaf, have no other intervals than the little spaces that result from the contact of this sort of cylinder; nevertheless, in plants that have pores (*stomata*) on the upper surface of their leaves, as is the case in most herbaceous plants, and in such as float on the surface of the water, there exist here and there, among the vesicles, some large spaces, through which the pores communicate with the interior of the leaf. This pulp is entirely different from what is found beneath the rind of the lower side. There, instead of consisting of regular cylindrical vesicles, it is composed of irregular ones, often having two or three branches, which unite with the limbs of the vesicles next them, and so form a sort of netted pulp; the spaces between whose vesicles are much larger than the vesicles themselves.

In most cases this netted tissue with large spaces in it, to which the name of cavernous or spongy pulp might not improperly be applied, occupies at least half the thickness of the leaves between the leaf ribs. The arrangement of the vesicles is very obvious if the lower rind of certain leaves be lifted up with the layer of pulp that is applied against it; it may then be seen that these vesicles, reciprocally uniting, form a net with large meshes—a sort of grating inside the rind. It must not, however, be supposed, that this structure, which I have remarked in several perus, and in a great many plants with two seed lobes, is without exception. In many one seed lobed plants we have some remarkable modifications of this structure: thus, in the lily, and several plants of the same family, the vesicles of the pulp that are in contact with the under rind are lengthened out, wavy, and toothed, as it were, at the sides; these projections join those of the contiguous vesicle, and a number of cavities is the consequence, which render this sort of pulp permeable to air. An analogous arrangement exists in the lower pulp of goat's rue (Galega). In the Iris, there is scarcely any space between the oblong and many sided vesicles which form the pulp; but it is remarked, that the subjacent pulp is wanting at every point where the cuticle is pierced by a pore (*stoma*). In such succulent plants as I have examined, the spaces between the little cells of pulp are very small; but, nevertheless, here and there, there are often larger cavities, which either correspond with the layer of cylindrical and parallel vesicles; in such cases, there are, here and there, between these vesicles, empty spaces, which almost always correspond to the points where the pores exist, and which permit the air to penetrate between the vesicles as far as the middle of the pulp of the leaf.*

* Magazine of Botany and Gardening.

THE FAN PALM.

A CORRESPONDENT has enabled Professor Rennie thus to figure in his ably conducted *Field Naturalist's Magazine,* a leaf of the gigantic fan palm. The writer says:—These threads break away from the leaf in the process of expansion, and hang like fringes to the magnificent foliage. The leaf varies from six



to nine feet in diameter, a magnificent specimen of vegetation in these gardens of the sun. When passing through a forest and overtaken by a shower of rain, myself and horse found shelter from the wet under a single leaf of one of the young low trees. I rode under it, and, seated on the horse, remained there secure from the wet for the space of an hour. The rain spurting off all around me, in the channels of the leaf, was conveyed along the line of each depending filament, between fold and fold, in little streams, so as to fall quite clear away from me.

Of the twine-like fibres of this leaf the golden-banded Oriole weaves its nest, which it suspends by loops like a hammock in the tree.—For an engraving of this nest, see page 187.

INFLAMMATION OF THE FRAXINELLA.

By M. Biot.

Among the physical phenomena which are produced during vegetable life, phenomena which might become a subject of curious study, there are few whose developement appears more surprising than that which is generally attributed to the fraxinella, viz., that of being surrounded in hot days, with a sort of ethereal atmosphere, which can be ignited by the application of a taper without injuring the plant. Such a phenomenon in fact would seem to require, that the inflammable vapour should be, as it were, prevented from expanding by the vital action, or else that its emission continually renewed, should always keep it dense around the plant, in proportion as it tended to expand in the external air, two states of things equally difficult to conceive. So singular a fact, however, is known only in a general way among botanists, without their having observed it themselves, and accurate details of it are to be found only in Deterville's *Dictionary of Natural History*, where Bosc thus says: "the extremities of the stalks, and the petals of the flowers of the fraxinella, are filled with an immense number of vesicles full of essential oil. On the hot days of summer they diffuse a strong-scented vapour, inflammable, and so abundant, that if, towards evening when a cooler air rendered it a little denser, we bring a lighted taper near the fraxinella, there appears all on a sudden a great light which spreads over the entire plant, without injuring it." Chance having afforded me an opportunity of witnessing these phenomena of inflammation of the fraxinella, I determined to study their cause and physical conditions.

At first supposing, with those who have described the matter, the reality of an ethereal emanation which encompasses the plant, I instituted according to this view different experiments, but none with any success. I then directed my attention to the examination of the cortical vesicles, whence it was said that this inflammable atmosphere emanated. These vesicles, when observed with the microscope, present the form of small bottles, terminated by a sort of conical neck tapering to a point at its extremity. They have been very accurately represented by M. Mirbel in his "Elements of Vegetable Anatomy and Physiology." These are found distributed more or less numerously over every part of the stalk; they are seen in greater abundance on the peduncles of the flowers, principally in their lower surface, at the extremity where the flower is inserted; we may still follow them on the borders of the leaves of the calyx, on the borders and nerves of the petals, on the stamens and style; in fine, their grains more condensed thus cover all the surfaces of the ovaries, when they are enlarged by fecundation. Among these utricles some are sessile, others pediculated, the latter in different parts, but more frequently on the most vigorous. Very

small at the commencement of vegetation, they become enlarged according as the plant increased. Their surface seen with a microscope in a strong light, exhibited itself commonly speckled with red and green, in the variety with the red flower; but it is all green in the white flower variety. The interior is filled with a colourless liquid, through which the light is refracted to a focus. I frequently saw at the extremity of this point a small limpid drop, as if a part of the interior liquid, dilated by increase of temperature, or secreted by the vital action, had flown out. These observations led me to think that the developement of the flame around the plant might be the result of simultaneous inflammation, or almost instantaneously propagated from these numerous utricles filled with essence. On this supposition the heat of summer was not necessary for the actual production of the phenomenon, but merely for the maturation of the inflammable liquid contained in the utricles; once the utricles were formed and ripened, the cold or heat of the time could not interfere, any more than the time of the day. The ignition must be effected merely by the contact of the inflamed body, or at least nearly by its contact in order to make the utricles burst. In fine, it must be accomplished with the characters of suction and of propagation suitable to small globules lying in juxtaposition, filled with an inflammable liquid, not with the instantaneous simultaneousness of a volume of gas. This is the mode of viewing the phenomenon, to which I have been led by all the experiments which I have made, some of which I shall here state.

The 26th of April, 1830, I tried to apply the flame of a match to the peduncle of a flower of the red variety, which appeared to me already charged with a certain number of utricles considerably distended.

I did not obtain continued inflammation, but mere local crepitation, similar to those produced by jets of the essence contained in the orange peel, when pressed and held near the flame of a taper. The remainder of the plant where the utricles were smaller and fewer did not present even this phenomenon. I repeated the experiment the following year, and at the same time of the year, with similar results. In the parts where the crepitations were produced, the utricles appeared obliterated and blackened.

On the 15th of May, 1830, several flower stalks had acquired full developement: the utricles were considerably expanded and closely set on their surface. The entire day was cold and dry: in the evening the temperature being at 49° F. I repeated the attempt to inflame, the attempt succeeded when the flame was applied beneath the peduncles of some flowers fully developed, or only partly expanded, particularly near the commencement of these flowers, where the utricles are always more abundant. The inflammation though manifest, was not sufficient to pass spontaneously from the base of one flower to that of another; it was

necessary to excite it at each point in succession, which I did with sufficient gentleness not to injure the stalks. Among those which presented the phenomenon, there were some which I had in vain tried the preceding April; some others, whose utricles having been inflamed were destroyed, might still after the lapse of a week be ignited anew, no doubt in consequence of other utricles having come to maturation since the preceding experiment. In the third attempt on the 22nd May, the developement of the plant being more advanced, the inflammation was excited with great intensity over all the stalks. I have frequently since produced a repetition of the phenomenon on the same flower stalk at different periods; and having become more dexterous in conducting the process, I have been able to reproduce it seven or eight times this year in a sensible degree on the same stalk, by choosing successively its different parts to apply the inflammation to them. It is not necessary that the experiment should be made particularly in the evening any more than at any other time. In fine, the inflammation is always propagated from below upwards over an entire bunch of flowers, but with much more facility from above downwards; it may also take place on the peduncles of the centre without occurring on the lateral peduncles, though they may be in a fit state to receive the inflammation, by approximating the flame separately to their surface. This possibility of succession in the phenomenon of ignition, as well as of its insulation, is very easily understood for a system of globules separately distributed over all the parts of the plant, but it cannot exist for a continuous mass of inflammable vapour, such as that with which the fraxinella was supposed to be encompassed. The phenomena just described are produced on all the varieties of the fraxinella, whether the red-flower or white-flower variety, less easily, however, and less abundantly on the latter, its utricles appearing smaller and fewer. It is known that external temperature, by modifying the progress of maturation considerably influences the absolute quantity of essential oil produced by the same vegetable. The cold constitution of this year seems to have thus acted on the phenomenon just described; the utricles of the fraxinella are smaller, and their inflammation appears less abundant than in preceding years.*

NEW OBSERVATIONS ON THE DIRECTION OF STEMS AND ROOTS.

By M. Dutrochet.

The phenomenon of the ascent of roots, which the author, in a preceding memoir, had noticed in the cactus, is particularly remarkable in the plants of the genus pothos. Of those considerably large roots which grow in the air at a short distance above the soil, some are often seen which have a vertical direction upwards, whilst others descend towards the ground. This circum-

* Annales de Chimie.

stance was observed principally by M. Dutrochet in the pothos, mexicana, crassi nervia, and digitalis; he even saw in the latter species some roots which, after having been developed horizontally in the superficial part of the soil, became elevated all at once in the air, and pointed towards the sky. In all these roots, observation induced him to recognise a cortical system very considerable, and a central system very deficient. Now, this fact seems to contradict the principles laid down by the author in his preceding memoir, since, according to it, it is in virtue of the predominance of this cortical system that the roots assume a descending direction. However, this apparent contradiction, far from overturning the theory, is but a striking confirmation of it.

In fact, the general type of the organization of the cortical system is the decrease from without and within of the utricles which compose the system. It is this order of decrease which determines the incurvation inwards of this system, and consequently the descent of the stems in which this system predominates. Now, by a single anomaly, the cortical system of the aeriel and ascending roots of the pothos is found to be composed of utricles decreasing from within outwards in almost all its thickness; near the central system there is but an inconsiderable layer of utricles, which decrease in size outwards and inwards. The result of this arrangement is, that the cortical system, always predominating, as in the ordinary case, acts, however in the opposite way, and thus its effect is to bend the roots up. The subterraneous roots of the pothos have the general organization of the roots, that is to say, their cortical system is composed of utricles decreasing from without inwards. It appears to M. Dutrochet that the contrary arrangement notable in the aerial ascending roots is owing to the drying power of the atmosphere, which tends to waste the vesicles with so much the more effect in proportion as they are nearer the surface. If this wasting does not penetrate too deeply, the roots descend, and the tendency they have to shun the light also favours the descending movement.*

GEOLOGY.

ON THE HOT SPRINGS OF THE CORDILLERAS OF THE ANDES.

At a meeting of the Academy of Sciences of France, held on the 18th of March, M. Boussingault red a memoir on the temperature of the hot springs of the Cordilleras of the Andes. The theory originally proposed by Laplace to account for the heat of those springs, and which is grounded

* Revue Medicale.

on the supposed existence of a high temperature in the interior of the earth, seems confirmed by a multitude of phenomena presented at various points of the Cordilleras. Thus, on the coast chain of Venezuela, the temperature of the hot springs diminishes as the absolute height increases. For instance, the hot spring of Las Trincheras, near Puerto Cabello, and which is situated nearly at the level of the sea, has a temperature of 97° cent.; that of Mariara, at a height of 476 metres, has only a temperature of 64° cent.; and that of Onato, which has an elevation of 702 metres, has only a temperature of 44°·5 cent.

But in the trachytic formation, especially in the vicinity of volcanoes, this regular decrease in the temperature of hot springs does not present itself; and it seems that in such cases the local cause producing the volcanic action has a marked influence on the temperature of the waters. It becomes, then, extremely interesting to determine if these hot springs have their origin near the seats of volcanic action. In order to solve this question, it is necessary to submit to chemical examination the hot waters occurring near volcanos, particular attention being paid to the nature of the gases they may contain. If these gases should prove to be the same which are recognised in active craters, we would obtain a strong argument for believing, that the water of hot springs has been in contact with the substances occurring in the sources of volcanic eruption. The determination of the saline substances contained in mineral waters would thus gain a new degree of importance, as these salts must then be considered as the soluble products which exist or are formed in the interior of volcanos. Such are the various considerations which induced M. Boussingault to undertake the analysis of the hot springs he has met with during his travels, and the memoir read to the Academy presents the results. The conclusion drawn from the numerous analyses performed is, that the gases accompanying the hot springs, which have their sources near volcanos, are identical with those of the craters of the same volcanos, viz. carbonic acid and sulphuretted hydrogen gases. It is then probable that the hot waters of the trachytic formation of the equator owe their elevated temperature to subterranean fire, and it is equally natural to believe, that the salts dissolved in these waters are derived from the interior of volcanos. Before terminating this memoir, the author examines the question as to the variation of temperature of the hot springs he investigated. In 1800, M. de Humboldt found the temperature of the *Mariara spring* to be 59°·3 cent. In 1823, M. Boussingault and M. Rivero found the thermometer in the same spring rise to 64° cent. A difference so considerable, viz. of 5°·3 cent, cannot be attributed to an error in the instrument, especially as the thermometrical observations made by those gentlemen at La Guayra and Caraccas accord perfectly with those made in the same towns by M. de Humboldt. It is more to be feared that as the spring of Mariara forms a considerable stream, the observations may not have been made precisely at the same point, although in general an observer who determines the temperature of a hot spring endeavours to find the spot where the hot water is hottest. But the objections which can be raised to the observations made at the Mariara spring are quite inapplicable to those made at the spring of *Las Trincheras*, near *Puerto Cabello*. At Las Trincheras, the water issues from two basins which lie close one to the other, and are hollowed in granite. The larger basin has a capacity of about two cubic feet. M. de Humboldt gives 90° cent. as the temperature of the water of Las Trincheras. Twenty-three years later, Messrs. Boussingault and Rivero found the temperature of the

water in one basin to be 92°·2 cent., and that of the water of the other 97° cent. Their observations, like those of M. de Humboldt, were made in the month of February. It appears, therefore, that in the short period of twenty-three years, the springs of *Mariara* and *Las Trincheras* have received an addition of several degrees to their temperature. It is remarkable that during the interval between the travels of M. de Humboldt and Messrs. Boussingault and Rivero, Venezuela was visited by the earthquake of the 26th March, 1812, which destroyed the town of Caraccas, and indeed all the towns situated on the eastern Cordillera, and death of upwards of 30,000 individuals.*

INSTANCES OF GROUND ICE.

A STRIKING example of the formation of *ground-ice* is mentioned by the Commander Steenk of Pillau. On the 9th February, 1806, during a strong south-east wind, and a temperature of + 34° ·2 Fahrenheit, a long iron chain, to which the buoys of the fair-way are fastened, and which had been lost sight of at Schappelts-wrack in a depth of from 15 to 18 feet, suddenly made its appearance at the surface of the water, and swam there; it was, however, completely encrusted with ice to the thickness of several feet. Stones, also of from three to six pounds weight, rose to the surface; they were surrounded with a thick coat of ice. A cable also, 3½ inches thick, and about 30 fathoms long, which had been lost the preceding summer in a depth of 30 feet, again made its appearance and swam on the surface; but it was enveloped in ice to the thickness of two feet. On the same day it was necessary to warp the ship into harbour in face of an east wind; the anchor used for the purpose, after it had lain an hour at the bottom, became so encrusted with ice, that it required not more than half of the usual power to heave it up.†

HOFFMAN'S DISCOVERY IN REGARD TO CARRARA MARBLE.

ACCORDING to the late investigations of Hoffmann, the famed marble of Carrara belongs to the Jura limestone formation, and even corresponds to the upper part of that deposit which affords at Solenhof and Pappenheim the well known lithographic stone. The limestone is observed rising from under the quader sand-stone, at first but little changed, and in this state abounding in petrifactions the same as those that occur in the Jura limestone. With increased inclination of the strata, they become more granular, and often alternate with large masses of dolomite at length, in an immense wall, which in a length of six German miles, scarcely sinks to a lower level than 4,000 feet above the sea, the limestone becomes throughout granular, and loses every appearance of a common Jura limestone. But, in descending towards Carrara, the Jura petrifactions appear again in the deeper beds, below Miseglia, in a road which leads to the marble quarries, and thus, according to Hoffmann, showing that the beds of granular limestone or marble have been formed out of compact limestone, through subterranean agency. The marble rests on clay-slate, which reposes on a mica-slate, supported by gneiss. Hoffmann endeavours to show that the mica-slate and gneiss have been formed from the clay-slate, through the agency of subterranean heat.‡

* Jameson's Journal. † Ibid. ‡ Ibid.

ORIGIN OF THE DIAMOND.

On Feb. 27, a paper entitled "Observations relative to the Structure and Origin of the Diamond," by Sir David Brewster, K.C.H. LL.D. F.G.S. &c., was read before the Geological Society.

In the year 1820, the author communicated to the Royal Society of Edinburgh a singular fact relative to the structure of the diamond, accompanied with some conjectures respecting the origin of this remarkable gem:—the present essay may be viewed as a continuation and extension of the same inquiry.

The author refers to the remark of Newton, that amber and the diamond have a refractive power three times greater in respect of their densities than several other substances; and he quotes Newton's conjecture, founded on that remark, of the diamond being probably, like amber, an unctuous coagulated. In proof of the intimate relation between the inflammability and absolute refractive power of bodies, Sir D. Brewster adds the facts, that sulphur and phosphorus exceed even the diamond in absolute power of refraction, and that these three inflammables stand before all solid and fluid substances in their absolute action upon light.

Another close analogy between the diamond and amber, independently of their like locality and carbonaceous nature, was traced by the author in their polarizing structure. Both of these minerals contain within their substance small cells or cavities, filled with air, the expansive force of which has communicated a polarizing structure to the parts in immediate contact with the air. The description of this structure, which is displayed from sectors of polarized light encircling the globule of air, is illustrated by drawings.

The author contends that the peculiar polarizing power around the cavities in amber and in the diamond must have been occasioned by the expansive force of the confined substance, supposed to be gaseous, compressing the sides of the cells, while the substance of the minerals was in a soft and yielding condition. A similar structure may be produced in glass, or in gelatinous masses, by a compressing force, propagated circularly from a point.

Having thus shown that the diamond was at one time in a soft or pasty state, the author argues that this state was not produced by igneous fusion. For in his laborious examination of the cavities in crystals, both natural and artificial, such as topaz, quartz, amethyst, chrysoberyl, &c. and in salts, he observed the condition of many thousand cavities; but in no case, neither in crystals formed by means of igneous fusion nor by aqueous solution, did he observe a single cavity in which the expansible fluid within had communicated a polarizing structure, similar to that around the cavities in the diamond. He believes, therefore, that the softness must have been that of semi-indurated gum; and that the diamond was derived from the decomposition of vegetable matter, as is admitted to have been the case with amber. The crystallized condition of diamond is not to be considered as decisive against this inference, since the mineral called mellite has a distinct crystallized form, while its composition and locality attest a vegetable origin.*

* Philosophical Magazine.

ON FOSSIL-BONE CAVERNS.

M. Tournal, jun., of Narbonne, concludes from a great variety of facts and observations, that,

1st, The bones buried in caverns have been introduced in several different manners.

2ndly, The species buried vary in different localities; and this difference depends either upon the period of deposition or the geographical position of the cavern.

3rdly, Man was contemporary with the lost species of animals which are found buried in the mud of the caverns; and these animals being regarded by all naturalists as fossil, man, therefore, exists in the fossil state.

4thly, The mud and pebbles found in the bone caves were not introduced by any sudden and temporary cause, as by a deluge, but on the contrary, almost always slowly, and in several different modes.

5thly, The attentive examination of the pebbles contained in the mud proves evidently that they have been introduced from neighbouring places, and consequently, that the cause which conveyed them was entirely local.*

MINES OF FREYBERG IN SAXONY.

The mines of Beschertglück and Himmelfürst, which have been for a long time among the most important resources of Saxony, are now greatly reduced; but, on the other hand, new mines have become flourishing.

The execution of a great project of drainage is at present depending on the determination of the states, now in session. There has been discovered, a league from Freyberg, a bed of alluvium of *rutile* or titanic oxide, so abundant that preparations are making to obtain it by washing, (Seisenwerck). It is intended to employ this titanium in the dyeing of cotton fabrics. There is now obtained, near Schwarzemberg, very fine emery, (corundum,) the quality of which is as good as that of Naxos. It is now worked to a considerable extent.

Note on the Emery of Saxony.—The emery of Ochenkopf and Morgenleithe, near Schwarzemberg, is found in grains, or small bluish, kidney-form agglomerations, mixed with blende and other minerals, in a yellowish, talcose or jade rock, constituting a bank in a stratum of micaceous schist passing into slate. Formerly this rock was employed in mending roads; in 1714, it was found to be useful in sawing and polishing hard stones.†

ON COAL.

On January 9, an essay, entitled "Observations on Coal," by W. Hutton, Esq., F.G.S. was first read before the Geological Society. The author was led to the observations contained in this essay by pursuing the method of microscopic examination which has been so successfully employed by Mr. Witham. On examining, with the microscope, one of the thin slices of coal in which Mr. Witham lately discovered a distinct vegetable texture, the attention of the author was excited by the remarkable appear-

* Philosophical Magazine. † Annales des Mines.

ance of several cells in that part of the coal where the texture of the original plant could not be distinguished. Tempted to extend the inquiry, he procured an extensive series of slices, taken from the several varieties of coal found at Newcastle and the contiguous district.

The coal of the Newcastle district is considered by the author to be of three kinds. The first, which is the greatest in quantity and the best in quality, is the rich caking coal so generally esteemed; the second is Cannel or Parrot coal (Splent coal of the miners;) and the third, the slate coal of Jameson, consists of the two former, arranged in thin alternate layers, and has, consequently, a slaty structure. In these varieties of coal, even in samples taken indiscriminately, more or less of the vegetable texture could always be discovered; thus affording the fullest evidence, if any such proof were wanting, of the vegetable origin of coal.

Each of these three kinds of coal, besides the fine distinct reticulation of the original vegetable texture, exhibits other cells, which are filled with a light wine-yellow-coloured matter, apparently of a bituminous nature, and which is so volatile as to be entirely expelled by heat before any change is effected in the other constituents of the coal. The number and appearance of these cells vary with each variety of coal. In caking coal, the cells are comparatively few, and those which do exist are highly elongated. Their original form the author believes to have been circular; and he attributes their present figure to the distention of gas confined in a somewhat yielding material, subject to perpendicular pressure. In the finest portions of this coal, where the crystalline structure, as indicated by the rhomboidal form of its fragments, is most developed, the cells are completely obliterated. In such parts the texture is uniform and compact: the crystalline arrangement indicates a more perfect union of the constituents, and a more entire destruction of the original texture of the plant.

The slate-coal, or the third variety above mentioned, contains two kinds of cells, both of which are filled with yellow bituminous matter. One kind is that already noticed in caking coal; while the other kind of cells constitutes groups of smaller cells of an elongated circular figure.

In those varieties which go under the name of Cannel, Parrot, and Splent Coal, the crystalline structure, so conspicuous in fine caking coal, is wholly wanting, the first kind of cells are rarely seen, and the whole surface displays an almost uniform series of the second class of cells, filled with bituminous matter, and separated from each other by thin fibrous divisions.

After describing these appearances, and illustrating them by drawings, the author proceeds to speculate on the origin of the cells in Cannel coal. He considers it highly probable that they are derived from the reticular texture of the parent plant, rounded and confused by the enormous pressure to which the vegetable matter has been subject.

The author next states, that though the crystalline and uncrystalline, or, in other terms, perfectly and imperfectly developed, varieties of coal generally occur in distinct strata, yet it is easy to find specimens which in the compass of a single square inch contain both varieties. From this fact, as also from the exact similarity of position which they occupy in the mine, the differences in different varieties of coal are ascribed to original difference in the plants from which they were derived.

The author next adverts to the escape of inflammable gas from coal, and cites various interesting facts, principally from the authority of Sir H. Davy and Mr. Buddle, in proof of the existence of inflammable gas ready formed in coal while contained in the mine; of the immense quantity which

is sometimes emitted by blowers, indicating a free communication between the reservoirs in which it resides; and of the great pressure to which it is there subject. He ingeniously shows the probability of the gas existing within the coal in so compressed a state as to be liquid. A consideration of these circumstances induced the author, while engaged in his microscopic inquiries, to search for a structure in coal capable of containing gas; and he accordingly discovered a system of cells, different from any before mentioned, and apparently adapted for that purpose. These supposed gas cells are found empty, are generally of a circular form, occur in groups which communicate with each other, and each cavity has in its centre a small pellet of carbonaceous matter. The author establishes a clear distinction between these gas cells and those above described as being filled with bituminous matter; for the anthracite of South Wales contains the former, but is quite free from the latter. He also states, on the authority of Mr. F. Foster, that the anthracite of South Wales affords a free disengagement of inflammable gas when first exposed to the air.*

GRAHAM ISLAND.

The reader may recollect the disappearance of this volcanic island, as described in the *Arcana* of last year. By a recent survey, it has left in its place a dangerous shoal of an oval figure, about three-fifths of a mile in extent, having its longest diameter from S.S.E. to N.N.W., and being somewhat less in size than the base of the island itself when visible. The upper surface is composed principally of black stones, and some of a darkish yellow, exactly like those observed round the crater of the volcano, with an occasional sprinkling of sand. In the centre is a black rock twenty-six fathoms in diameter, over which there are eleven feet of water, with the exception of two points in the line from N.E. to S.W. which have a depth of only nine feet. At the distance of sixty fathoms from the central mass, there are from two and a half to six fathoms of water, the depth of which increases with the distance. At seventy-five fathoms from the S.W. of the central rock, there is a small detached rock, with fifteen feet water over it. In every direction around this danger, the depth is great. Neither the barrel placed there by Captain Swinburne, in 1832, and which could scarcely make any resistance, nor the discoloured water observed by him, are any longer to be seen. By means of a tolerably correct survey, made with an exact azimuth compass, the vessel being in the direction of the shoal, (upon which a boat was stationed,) and the highest part of the island of Pantellaria, these two points were seen bearing N. 54° E. and S. 54° W. The latitude of the point upon which the boat was moored, was found to be 37° 10′ N.; and, with the assistance of a chronometer, whose daily progression was precisely known, the longitude was fixed at 12° 44′ 59″ E. of Greenwich. The latitude of the volcano, taken by Commander W. Smith, of the English brig-of-war, Philomel, when in a state of eruption, was 37° 11′ N. and the longitude 12° 44′ E. An engraving of the island, in eruption, will be found in the *Arcana*, 1832.

CARBONATE OF LIME.

At a meeting of the Royal Society of London, on May 3, Mr. Faraday read a notice on the combination of carbonic acid with lime.

* Philosophical Magazine.

After some details on the importance of carbonate of lime, the variety of forms under which it occurs, the different applications for economic purposes, for marl, manure, smelting in metalling operations, &c. he called the attention of the members to the fact, that carbonate of lime, when heated without the presence of any other gas but carbonic acid, did not lose its carbonic acid, whatever may be the intensity of the heat employed, and under the common atmospheric pressure. An analogous fact is the occurrence in lime-kilns of masses of limestone that have been softened and crystallized without the loss of their carbonic acid. Probably pressure has little to do with the retention of the carbonic acid during the fusion of carbonate of lime. The absence of moisture, as well as the presence of carbonic acid, may contribute powerfully to the retention of the carbonic acid.*

FOSSIL ORGANIC REMAINS.

Bedford.—On Jan. 17, 1833, some labourers in digging brick earth near the town of Bedford, discovered the caudal vertebræ of a *Plesiosaurus*, and subsequently fragments of ribs, and then the left fore-paddle. This fin or paddle was 3 ft. 9 in. long, from the shoulder-bone to the tip of the phalanges; and 1 ft. 2 in. wide at the broadest part of the bladebone: at the part between the metacarpal bones and the phalanges, it was 8 in. wide. The phalanges were 2 and a half inches long, by 1 and a half wide, at each extremity: in the middle their diameter was less. There were four rows of phalanges; and seven in the first row, eight in the second, eight in the third, and four in the fourth. The neck was about 3 ft. 6 in. long; the vertebræ displaced for about 1 ft., then straight for 2 ft., then bending to the left for about 6 in. No head was found. About twelve of the cervical vertebræ are remaining, and are pretty hard, but none of the hatchet-like appendages adhered to them on their removal. Neither a right fore paddle nor a left hind one was discovered, nor any dorsal vertebræ. The soil in which the skeleton was found was a strong clay or gault (the "clunch clay") of Bedford, about 5 and a half ft. beneath the surface of the earth, and 3 ft. beneath that of the gault. The body of the animal was completely encased with hardened clay and some siliceous matters cemented together by a substance very similar to the divisions in the Septarium: one half of an ammonite, and one large fragment of belemnite were among the stones. It is perhaps worthy of observation that no stones similar to those in which the animal was embedded have ever been found in that neighbourhood; and, as the animal was found on the slope of a knoll of ground, close to which is a hollow, which tradition assigns as the ancient bed of the river Ouse, it may be conjectured that the animal, in floating down the stream, may have lodged against some obstruction, and, by causing a greater one have stopped a number of stones, that would otherwise have been washed further down the stream. The fragments of bone now are very ponderous, and have become very hard, and are of a deep reddish-brown colour where they are broken, and they were so embedded in and fastened to the stones, that it was quite impossible to separate them. The computed length of the animal, as far as could be judged, was between 17 ft. and 18 ft.; and the width between the two fore paddles must have been nearly 2 ft. The field is in the parish of St. Paul, in the borough of Bedford, adjoining the road between Bedford and Higham

* Jameson's Journal.

Ferrers, between that road and the river Ouse, and about one mile from the centre of the town of Bedford. Fragments of a head of one of the saurian tribe was found about 20 ft. behind this animal, but no teeth were with it: and also a leg bone of very large dimensions; one joint is 1 ft. 10 in. long, by 4 in. wide.*

Leicestershire.—Mr. Joseph Holdsworth has discovered at Billesden Coplow, a *real outburst* of a stratum of coal (accompanied by all its usual concomitants), and which has been distinctly traced, by numerous sinkings, for a distance of nearly three miles, along its longitudinal line of bearing; the coal with the accompanying measures dipping into the basin where the trial is being made, and where they have all been found lying in the regular successive order indicated by their crops or bassets. The adventitious hills, &c., which surround those measures, abound in masses, fragments, and thin veins of coal and coal-smuts, which, though possessing no decisive characters in themselves, are, so many signs of the coal neighbourhood: these indications have been investigated, and their importance confirmed, by the testimony of experienced geologists and practical men. The whole of the measures hitherto explored have been of the most promising description and decisive character as real coal-measures, and found lying in the most regular stratified order: the first 25 fathoms, consisting of strong slaty bind, contain about 9 solid feet of excellent iron-stone, in beds from 3 to 10 inches thick; immediately below this, about 30 feet of dun marl or free-stone bands are found, alternating in layers from 1 to 3 inches thick; to these succeed a grey rock 27 feet thick; 20 fathoms of hard grey or free-stone bands then occur, divided by thinnish strata of beautiful light blue and black shales, containing 2 thin veins of coal; under these rocks lie 7 fathoms of a hard bastard dun, all much impregnated with coaly matter; below this, an exceedingly hard striped rock occurs, 30 inches thick; then a red dun, or rather shale, $1\frac{1}{2}$ fathom; then a rock, beautifully striped with black, white, brown, and dun, about $3\frac{1}{3}$ fathoms; next a brown dun, about 3 fathoms; and, lastly, a strong black shale, occasionally finely striped with white: the whole of the measures have been *proved* (as colliers term it) by washings, and almost every inch of the last 30 yards has partaken very largely of the coal itself, which has gradually increased in quantity down to the present depth; in the sediment yielded by the washings of the last few yards, the proportion of coal has been more than one half!

On the above spot also, Mr. Holdsworth has discovered, from eleven to sixteen feet from the surface, and below two regular strata of iron-stone a vast number of *fossil fruits*, of different species, and accompanied with a variety of other vegetable remains. The following are particularly distinguishable: viz. fruit resembling a large walnut, partly enveloped in the outer husk, the shell and kernel presenting very evident characters of resemblance; several others of this kind, mostly inclosed in the green or outer rind; another, like a peach or nectarine, with stone in the centre; the top of a pear; one similar to an orange, in a very perfect state of preservation, showing the rind and quarters; small nut; fir-apples, and other fruits of large dimensions, perfectly distinguishable as originally organs of fructification, but which cannot be identified with any now existing in this country. The ferruginous fluid which flows in great abundance through all the interstices of the stratum in which the fruits,

*Abridged from the communication of Mr. E. R. Williamson, Hon. Sec. Bedford General Library; to the Magazine of Natural History.

&c., are deposited, has converted all the above-named vegetable and other substances into a substance of its own nature. Some of the fossil fruits have been shown to several of the most eminent botanists, chemists, mineralogists, &c., in London, who have (with but one exception) unanimously pronounced them of the order of *Carpolithes*, or fossil fruits and seeds; and there exists little or no doubt of their being natives of a tropical climate, or at least of a much warmer climate than this country has probably ever enjoyed, during the historical period.

Cork.—A Correspondent of the *Magazine of Natural History*, has discovered in lime-stone from the neighbourhood of Cork, Ireland, a fine specimen of the lily ecrinite. Parkinson says, "there is no part of the world in which this species has hitherto been known decidedly to exist, but in some of the states of Germany;" and, writing ten years later, he adds, "No remains of this species have been found in this island." In the lily ecrinite figured by Parkinson, the vertebral column is of the same bulk throughout, without any alteration in size as it approaches the point of attachment to the pelvis; but in the pear ecrinite, the vertebræ

are seen gradually increasing in diameter, until finally attached to the bones of the pelvis. In these specimens, however, (as figured by Parkinson, and in several specimens in the writer's own possession, from the oolite), the division of the vertebral column into separate joints is distinctly visible, and each joint presents a uniformity of structure.

The vertebral column, in the specimen figured, detached from the body of the animal, presents no unusual appearance. The bones of the pelvis, the scapula, the clavicle, the arms, and the fingers, present a uniformly solid and compact bony appearance: but from the pelvis to the termination of the fossil, there is a gradually diminishing process, without any appearance of joint, and which presents a lamellar structure, quite different from the other parts. This portion of the animal appears as if formed of thin plates passing over each other, like scales on a fish, and

which has suggested in my mind the idea that this portion was elastic. The tentacula are not visible in any connected form, but are thickly scattered over the stone.

An able geologist, to whose consideration this specimen has been submitted, knows of no previous instance of the occurrence of the lily ecrinite in the strata of Britain, nor does another geologist of eminence. He consequently deems Mr. Conway's discovery of great interest to geologists.

Mr. Murchison, F.R.S. &c., in retiring from the President's Chair, at the Anniversary of the Geological Society, Feb. 15, 1833, observed that the past Session had been fertile in communications, and continued as follows :

The splendid specimens of Megatherium, &c. brought to this country by Mr. Woodbine Parish have, in the hands of Mr. Clift, afforded us much more curious instruction. The Rev. Mr. Stanley has given a lively description of the caves of Cefn, in Flintshire, one of which, like that of Kirkdale, is supposed to have been the inhabited den of hyænas; whilst another and larger cavern, situated at a lower level on the side of the same mountain, contained only the remains of recent animals. From the distinct nature of the upper and lower layers of alluvia collected within the inhabited cave, and arranged above and below the floor of fossil bones, the author speculates on layers as evidences of different periods of aqueous debacle. Mr. Mantell, has presented us with an account of an undescribed and singular species of Saurian, to which he assigns the name of *Hylæosaurus*.

Mr. T. Hawkins, of Glastonbury, within the short space of two years, has disinterred numerous fine Saurians from the lias : among these we recognise a Plesiosaurus, so perfect, that it serves to commemorate the skill of Mr. Conybeare, whose elaborate restoration of the skeleton from one imperfect specimen is now amply confirmed.

A recent discovery of Miss Mary Anning, that indefatigable purveyor to the store-houses of our science, has furnished Mr. T. Hawkins with the disjointed fragments of an animal, which upon being reintegrated, proves to be the largest individual of the *Ichthyosaurus platyodon* ever yet found entire upon our shores.

Two Members of your Council, Viscount Cole and Sir Philip Egerton, have for some years entered zealously into the pursuit of fossil zoology, and have reaped a rich harvest, both on the continent and at home, having with their own hands brought to light some osseous relics unknown even to Cuvier.

M. Pentland, from the examination of a collection of fossil bones which had been consigned to his deceased friend, Baron Cuvier, has enlarged our acquaintance with the Fauna of Australia, by the addition of several new and undescribed species of animals, principally marsupial.

The " Palæologica" of M. Hermann Von Meyer, of Frankfort, brings together, in a synoptical form, all our present stock of knowledge of extinct vertebrated animals ; and being a compendious index to all the works written upon this subject, must be considered a necessary portion of every geological library.

Our distinguished Foreign Associate Von Buch has just produced a work upon Ammonites, which is intended to simplify the natural arrangement of this obscure class of fossil bodies.

A blank in fossil zoology is about to be filled up by Dr. Agassiz, of

Neufchatel, whose work on "Fossil Fishes" will furnish us with materials which we looked for from the pen of the lamented Cuvier.

Fossil Plants.—The early experiments of Hall and Hatchett, amplified and illustrated by Mac Culloch, had nearly produced conviction that all the varieties of carbonaceous matter, from the ill-consolidated surturbrand, through every stage of brown coal to pure jet; and in our older strata from anthracite to bituminous coal, were the products of vegetables. Botanists have since corroborated the soundness of these views, by developing the Flora of the associated strata; and one of our body has enabled us to refer many of these plants to their natural families in living nature, by an ingenious method of exhibiting polished sections of their stems: but it has been reserved to Mr. W. Hutton in pursuing this line of inquiry, to complete the solution of the problem by demonstrating the vegetable structure in coal itself. The Memoir of Mr. W. Hutton is further of high and practical utility in describing the source of those enormous volumes of imprisoned gases, which upon admixture with our atmosphere become explosive, and occasion such disastrous results to our miners.

As a slight contribution towards a knowledge of the condition of the surface of the earth during one of the periods in the formation of the oolitic series, which is marked by its vegetation, I offered to you a few remarks on the vertical position of the stems of Equiseti, in a sandstone of the eastern Moorlands of Yorkshire. This phenomenon extending over a large area is analogous to that observed in the Isle of Portland by Dr. Buckland and Mr. De la Beche; from which however it differs, as it appeared to me, in requiring for its explanation the desiccation of submarine sediments, so as to leave a stagnant marsh for the place of growth of these plants; which, after this marsh had been gradually silted up, were submerged by a fresh irruption of the sea, accumulating above them the deposits of the middle and upper oolite.

ASTRONOMICAL AND METEOROLOGICAL.

WATER SPOUT ON THE LAKE OF GENEVA.

M. Mayor, who resides at Molard place, Geneva, in looking through his window, which faces the lake, saw, to his astonishment, on the 3rd of December, 1832, about a quarter before eight in the morning, in the direction of *Paquis* and *Secheron*, a vertical column of water, at least sixty or eighty feet high, and several feet in diameter, larger at its base than its summit, of a grey colour and appearing animated with a gyratory motion. The column rested on the lake below, and was bent towards the top in the form of a bow. It remained nearly two minutes without any sensible change of place; and then sunk, by degrees, from above by diffusing itself in a shower of rain. At this juncture a south west wind ruffled the surface of the lake; the sky was entirely covered with thick vapours, which occupied the upper regions, while there were, properly speaking, no clouds in the horizon.

This is not the first spout seen on Lake Leman. One, which occurred

in 1741, was described in the French Academy. It lasted several minutes. Another was seen in 1764, in the month of August, which continued nearly an hour.

In the spout witnessed by M. Mayor, the top of the column had no communication with thick clouds, as is sometimes the case, no trace of any such cloud was to be seen, neither above the column nor in its neighbourhood,—hence there were no indications of electrical attraction to which the effect could be attributed, and there seems no means of accounting for the prodigious force then exerted to sustain a column of water of such height except that which ascribes it to a current of whirlwind of excessive intensity.*

INFLUENCE OF THE MOON ON RAIN.

From the comparison of a series of observations, continued for twenty-eight years at Munich, Stuttgard, and Augsburg, by Professor Schubler, it appears that the maximum number of rainy days takes place between the first quarter and the new moon. The number of rainy days in the last of these intervals, is to that in the first as 696 to 845, or in round numbers as 5 to 6. And this proportion is not only true of the twenty years taken together, but also of the separate groups of four years, which give analogous numbers; we therefore conclude that it rains more frequently during the increase than during the wane of the moon. The results maintained by Schubler receive support from a series of observations made by Pilgram at Vienna. On 100 repetitions of the same phase, Pilgram found the falls of rain to be as follows:—New moon 26, mean of the two quarters 25, full moon 29; consequently, at Vienna, as well as at Augsburg and Stuttgard, it rains more frequently on the day of the full, than on that of the new moon. Arago remarks in regard to the observations, "confining ourselves to the principal results, it seems difficult to resist the conclusion that the moon exercises an influence on our atmosphere; that in virtue of this influence rain falls more frequently towards the second octant, than at any other epoch of the lunar month; and, lastly, that the chances of rain are fewest between the last quarter and the fourth octant."†

THE SUPPOSED INFLUENCE OF THE MOON ON VEGETATION.

It is generally believed, says Arago, especially in the neighbourhood of Paris, that the moon, in certain months, has a great influence on the phenomena of vegetation. The gardeners give the name of *red moon* (lune rousse) to the moon, which, beginning in April, becomes full either about the end of that month, or more usually in the course of May. In the months of April and May, the moon according to them, exercises a pernicious influence on the young shoots of plants. They maintain that they have observed during the night, when the sky is clear, the leaves and buds exposed to this light, to become red, that is to say, to be frozen, although the thermometer in the free atmosphere stood several degrees above the freezing point. They also assert, that if the rays of the moon are intercepted by clouds, and thereby prevented from reaching the plants, the same effects do not take place, under circumstances perfectly

* Bib. Univ. † Jameson's Journal.

similar in other respects with regard to temperature. These phenomena seem to indicate that the light of our satellite is endowed with a certain frigorific influence; yet, on directing the most powerful burning-glasses, or the largest reflectors towards the moon, and placing the most delicate thermometers in their foci, no effect has ever been observed which could justify so singular a conclusion. Hence with philosophers the effects of the April moon are now referred to the class of vulgar prejudices, while the gardeners remain convinced of the accuracy of their observations. A beautiful discovery made some years ago by Dr. Wells, will enable us, I think, to reconcile two opinions in appearance so contradictory. No one had supposed, before Dr. Wells, that terrestrial substances, excepting in the case of a very rapid evaporation, may acquire during the night a different temperature from that of the surrounding air. This important fact is now well ascertained. On placing little masses of cotton, down, &c. in the open air, it is frequently observed that they acquire a temperature of six, seven, or even eight centigrade degrees below that of the surrounding atmosphere. The same is the case with vegetables. We cannot therefore judge of the degree of cold with which a plant is affected during the night, by the indications of a thermometer suspended in the free atmosphere: the plant may be strongly frozen, although the air remains constantly several degrees above the freezing point. These differences of temperature between solid bodies and the atmosphere only rise to six, seven, or eight degrees of the centesimal thermometer, when the sky is perfectly clear. If the sky is clouded they become insensible. Is it now necessary to point out the connexion between these phenomena, and the opinions of the country people regarding the April moon? In the nights of April and May, the temperature of the atmosphere is frequently only four, five or six centigrade degrees above zero. When this happens, plants exposed to the light of the moon, that is to say, to a clear sky, may be frozen, notwithstanding the indications of the thermometer. If the moon, on the contrary, does not shine—in short, if the sky is cloudy, the temperature of the plants does not fall below that of the atmosphere; and they will consequently not be frozen, unless the thermometer indicates zero. It is, therefore, quite true, as the gardeners pretend, that under thermometrical circumstances precisely alike, a plant may be frozen or not, according as the moon may be visible or concealed behind clouds. If they are deceived, it is only in their conclusion in attributing the effect to the light of the moon. The moon's light is, in this case, only the index of a clear atmosphere; it is only in consequence of the clearness of the sky that the nocturnal congelation of plants takes place, the moon contributes to the effect in no way whatever; although she were hid under the horizon, the effect would not be different.*

WEIGHT OF THE ATMOSPHERE AT NEW AND FULL MOON.

The weight of the air, says Dr. Prout, is observed to be very unsteady, and usually heavier about the new and full moon. Whether this arises from aërial tides has not been satisfactorily determined. It may, however, be proper to observe, that many of the minute differences in the weights of the air at different times are more apparent than real, and depend upon the sluggishness of the mercurial barometer, which prevents it from being an exact measure of the movements of the lighter and more mobile fluids.*

* Jameson's Journal.

ABSOLUTE WEIGHT OF THE ATMOSPHERE DURING CHOLERA GREATER THAN AT OTHER TIMES.

At a meeting of the British Association, Dr. Prout exhibited a table containing the results of eighty-seven experiments on the absolute weight of the atmosphere between the 16th of December, 1831, and the 24th of March, 1832. The experiments were usually made about noon, and as nearly as possible under similar circumstances. The following is a summary of the results:—The mean of all the experiments (with one exception, to be presently noticed,) is, that 100 cubic inches of dry atmospheric air, free from carbonic acid, at the temperature of 32°, barometer 30 inches, in the latitude of London, weigh 32·7958 grs., the extreme differences between the highest and the lowest observations being ·0507 grs. The mean of the first forty-four experiments, between the 16th of December and the 8th of February inclusive, is 32·7900 grs.; the mean of the last forty-four, between the 10th of February and the 24th of March inclusive, 32·8018 grs.; the difference between the two series being ·0118 grs. The exception alluded to above occurred on the 9th of February, on which day the weight of the air was 32·8218 grs.; and it is remarkable, that after this period, during the whole time that the experiments were continued, the air almost uniformly possessed a weight above the usual standard; so that, as above stated, the mean of the forty-two observations after this crisis exceeds the mean of the forty-four preceding it by no less than ·0118 grs. The apparatus employed, and the care taken, were the same throughout; and there can be no doubt, that the difference, whatever it depended on, really existed, and did not arise from error of experiment. How the circumstance is to be explained, it is difficult to form a conjecture; but perhaps it might be worth while to observe, that almost precisely at the period above mentioned, the wind veered round to the north and east, where it continued for a considerable time, and that under these circumstances the epidemic cholera first made its appearance in London. It would seem, therefore, as if some heavy foreign body had been diffused through the lower regions of the atmosphere about this period, and which was, somehow or other, connected with the disease in question. The action of this body is quite unknown; but it could have scarcely possessed acid or alkaline properties, as, in the former instance, it would have been separated by lime-water, and in the latter by sulphuric acid. We may probably consider it as a variety of *malaria;* and, what renders the conjecture more likely are its effects upon the animal economy, which are somewhat analogous to those known to be produced by certain varieties of this poison. Thus, during the present spring and summer, the saliva and the exhalations from the skin, in almost every individual on whom the experiment was made, have been found to be unusually acid; the state of the urine also, and other secretions, has been most remarkable, and that in so great a number of individuals as to prove the existence of some widely acting cause, such as has not occurred in our time, or at least since the author of the present communication has turned his attention to the subject. Should the above conjectures prove to be well founded, they lead us to hope that the cause of the present formidable epidemic will not be permanent, but will pass gradually away; though, from the deep-seated and malignant influence which it has exerted in organic action, it is probable that several years will elapse before its effects will be entirely obliterated.*

* Jameson's Journal.

THE WINDS.

At the anniversary of the British Association, Professor Airy stated that he had long made observations on the direction of the winds at the Observatory of Cambridge, from which some curious facts respecting these phenomena were elicited. He had found, for example, that the wind never blew steadily for any period of time except from eight points of the compass. When in any other quarter, it was merely shifting round to one of these points. It never blew at all directly from the south! The two most prevalent winds were the S.S.W. and W.S.W.; the one of which invariably brought rain, while the other was accompanied by dry weather. Between the W. and N. was one point of duration; between the N. and E. another; and another between the E. and S.S. W. (not having the diagram, we may not be perfectly correct,) which, with the N., the W., and the E., made the eight quarters alluded to, from which the winds blew for prolonged periods.

This communication excited a lively sensation; and it was confessed by all present that a number of local experiments on the subject must lead to very interesting meteorological conclusions. Where did the winds originate? how were they modified? how far did they sweep over the earth? and many other questions suggested themselves, as likely to be elucidated by this means; and the Professor suggested a mechanical contrivance to regulate and index the turning of a vane, by which the observations might be tolerably ascertained, and the duration and measure of intensity of the winds throughout the year obtained in many places.*

CLOUD ECHOES AND THE ROLLING OF THUNDER.

The rolling of thunder has been attributed to the echoes among the clouds; and if it is considered that a cloud is a collection of particles of water, however minute, yet in a liquid state, and therefore each individually capable of reflecting sound, there is no reason why very loud sounds should not be reverberated confusedly (like bright lights) from a cloud. And that such is the case, has been ascertained by direct observation on the sound of cannon. Messrs. Arago, Mathieu, and Prony, in their experiments on the velocity of sound, observed that, under a perfectly clear sky, the explosions of their guns were always heard single and sharp, whereas when the sky was overcast, or even when a cloud came in sight over any considerable part of the horizon, they were frequently accompanied with a long continued roll like thunder, and occasionally a double sound would arrive from a single shot.

But there is, doubtless, also another cause for the rolling of thunder, as well as for all its sudden and capricious bursts and variations of intensity, of which our knowledge of the velocity of sound furnishes a perfect explanation. To understand this, we must premise, *cæteris paribus*, the estimated intensity of a sound will be proportional to the quantity of it, (if we may so express ourselves,) which reaches the ear in a given time. Two blows equally loud, at *precisely the same distance from the ear*, will sound as one of double the intensity; a hundred, struck in an instant of time, will sound as one blow a hundred times more intense than if they followed in such slow succession that the ear could appreciate them singly. Now let us conceive two equal flashes of lightning, each four miles long, both beginning at points equi-distant from the auditor, but the one running out in a straight line directly away from him; the other

* Literary Gazette.

describing an arc of a circle having him in its centre. Since the velocity of electricity is incomparably greater than that of sound, the thunder may be regarded as *originating* at one and the same instant in every point of the course of either flash, but it will reach the ear under very different circumstances in the two cases.

In that of the circular flash, the sound from every point will arrive at the same instant, and affect the ear as a single explosion of stunning loudness. In that of the rectilinear flash, on the other hand, the sound from the nearest point will arrive sooner than from those at a greater distance; and those from different points will arrive in succession, occupying altogether a time equal to that required by sound to run over four miles, or about twenty seconds. Thus the same *amount* of sound is in the latter case distributed uniformly over twenty seconds of time, which in the former arrives at a single burst; of course, it will have the effect of a long roar, diminishing in intensity as it comes from a greater and greater distance. If the flash be inclined in direction, the sound will reach the ear *more compactly*, (i. e. in shorter time from its commencement,) and be proportionally more intense. If (as is almost always the case) the flash be zigzag, and composed of broken rectilinear and curvilinear portions, some concave, some convex to the ear, and if, especially, the principal trunk separates into many branches, each breaking its own way through the air, and each becoming a separate source of thunder, all the varieties of that awful sound are easily accounted for.*

REMARKABLE DEPOSITION OF ICE ROUND THE DECAYING STEMS OF VEGETABLES DURING FROST.

Some years ago during the first days of a sharp frost, Sir John Herschel's attention was attracted by the unusual accumulation of ice round the roots and stumps of some dry and decaying thistles in the fields; while at the same time comparatively little hoar-frost was deposited on wheat-stubble and other vegetables in the neighbourhood. On examination Sir John found it to incrust the stalks in a singular manner in voluminous friable masses, which looked as if they had been squeezed, while soft, through cracks in the stems. It was chiefly or entirely confined to the immediate neighbourhood of the root, the upper parts of the taller unbroken stalks being quite free from it. This peculiarity of situation, and the comparative absence of hoar-frost elsewhere, induced Sir John at the time to attribute it either to some different cause from hoar-frost, or to some singular modification of that atmospheric deposition by local and temporary circumstances.

The above observation was recalled to Sir John Herschel's recollection by a similar phenomenon noticed on the morning of the 11th of January, after a night of sharp frost, of the kind vulgarly called "a black frost;" there being little deposition of hoar-frost from the air, which was during the night extremely tranquil, with a scarcely perceptible current from the north-east. The stumps of a bed of heliotropes, which had been left out to try the chance of the season, were found to be affected with a similar and very copious accumulation of ice to what Sir

* Sir John Herschel, quoted in the Field Naturalist's Magazine.

John had before observed round the thistle-stalks. Fig. A shows the general appearance of this accumulation; while the mode in which it was attached to the stem, and seemed to emanate in a kind of riband, or frill-shaped wavy excrescence,—as if protruded in a soft state from the interior of the stem, from longitudinal fissures in its sides,—is exhibited at fig. B. The structure of the ribands was fibrous, like that of the fibrous variety of gypsum, presenting a glossy silky surface; the direction of the fibres being at right angles to the stem, or horizontal.

Although, as remarked, the icy sheets appeared to have been protruded from the interior of the stem, yet on examination they were found to terminate sharply at its surface, adhering to it so lightly as to render it impossible to handle a specimen without detaching them, and in no instance connected with any formation of ice within; on the contrary, the majority of the stems were sound and solid, and many of them still green when cut. The point of attachment of the ice was, however, always on the surface of the *wood*, beneath the outer bark or epidermis, which the frozen sheets had in every instance stripped off, and forced out to a distance. Where the fringes were large and well developed, the bark had quite fallen off; but in those cases where it adhered more strongly, it seemed to have prevented their free expansion; and in such instances the stem presented the singular appearance (*c*) of a thick massive coating of ice interposed between the wood and its integument, which was swollen and rifted.

The appearances above described are quite at variance with any idea of the deposition of these icy fringes from the store of aqueous vapour in the general atmosphere, in the manner of hoar-frost; and the only quarter to which we can look for their origin is in the plant itself, or in the comparatively warm earth beneath, to whose exhalations the decaying stems may form a kind of chimney. In the present instance, the season had been, up to the night in question, uncommonly mild and open; and the frost of

a single night being insufficient to penetrate far into the soil, it may easily be supposed to have been giving out moisture through every open spiracle. What share the physiological functions of the plant may have in the phenomenon, or whether it be connected with the vitality of the stem at all, it is for botanists to decide.*

STORM OF WIND.

On the evening of the 15th of October, a tremendous gale of wind nearly demolished the Suspension Pier at Brighton. The first bridge was materially damaged; the flooring of the second was driven down, the suspension rods snapped asunder, and the towers thrown out of the perpendicular: the whole of the centre of the third bridge was destroyed, and the wood-work, platform, railings, caps and all, for 30 or 40 feet, disappeared: the fourth bridge was also greatly distressed. The damage is in course of repair; its cause has not been satisfactorily explained, but it is generally attributed to the terrific force of the wind.

NORTH MAGNETIC POLE.

A memoir of the discovery of the North Magnetic Pole, by Capt. Ross, has been read before the Royal Society. Before leaving England, Capt. Ross had obtained from the Admiralty a dipping needle, constructed by Jones, whose accuracy had been tested in previous expeditions. From some defect in the vertical circle, the observations made prior to 1831, are not very perfect, but that defect was remedied when discovered. The table of observations showed, that the differences of observations were remarkable and great, but they also proved the tendency of errors to correct each other. When, from these observations, the direction in which the magnetic pole should be sought had been determined with tolerable precision, it was feared that it could only be approached by a land journey, the accomplishment of which was beyond the limited powers of the expedition. But these fears were dispelled by the discovery of the Great Western Ocean. The party first sent to explore, brought back only some imperfect indications of the object of their search, because they could only take with them a small supply of instruments; but when it appeared that another winter should necessarily be spent in these regions, Captain Ross made the necessary preparations for a more accurate survey. In May, 1831, he landed on the coast, and by a series of observations determined the place of the magnetic meridian, and, at least approximately, the position of the Magnetic Pole. Captain Ross detailed, minutely, all the tests used to determine that the place where he stood was the point of magnetic concentricity, and, so far as the evidence of instruments is decisive, the fact of the discovery was established. But he candidly added, that further investigations, and more especially accurate observations to the north-west and south-west of the place indicated, are necessary, to ascertain the limits of error. These investigations he deemed an object worthy of national attention, because magnetism was peculiarly a British science. Besides ascertaining the position of the pole, it would be also of importance to determine its diurnal and annual motion, and its periodic variations, if any such exist. The place ascertained to be either the precise spot, or one in its immediate vicinity was easily attainable; and he expressed his hopes that the British flag would soon wave on the Magnetic Pole.†

* Philosophical Magazine. † Athenæum.

METEOROLOGICAL SUMMARY OF 1833.*

MONTHS.	TEMPERATURE.				MEAN ATMOSPHERIC PRESSURE	PREVAILING WINDS.	RAIN.	HIGHEST DEW POINT.	PREVAILING MODIFICATION OF CLOUD.						
	Max	Min.	Med.	Greatest Variation			Mean Quantity in Inches		Cirrus.	Cirro-stratus.	Cumulus.	Cirro-cumulus.	Cumulo-Stratus.	Nimbus.	Stratus.
JANUARY	48	22	35	26	29.32	E. NE.	1.482	50		.			.		
FEBRUARY	58	29	43.5	27	29.065	S.W. N.W.	0.747	50		.	.		.	.	
MARCH	63	24	43.5	39	29.325	NW. NE. SE.	1.450	57		.	.	.	.		
APRIL	66	31	48.5	35	29.27	S.W. W. NW.	1.779	58		.	.		.	.	
MAY	98	44	71	54	29.84	E. NE. SW.	1.183	62	.	.	.		.		
JUNE	103	43	73	60	29.675	SW. W.	1.831	70	.	.	.	.	.	.	
JULY	90	42	66	58	29.965	W. NW. NE.	2.525	67		.	.	.	.	.	
AUGUST.....	84	42	63	42	29.775	W. NW. S.W.	1.453	69	.	.	.		.	.	.
SEPTEMBER	74	40	57	34	29.635	NW. SW. E.	2.192	65	.	.	.		.		.
OCTOBER	66	34	50	32	29.275	NE. NW. SE.	2.077	66		.	.		.		
NOVEMBER	64	28	46	36	29.425	SW. W. NW.	2.410	67		.		.		.	
DECEMBER	60	30	45	30	29.425	SW. W. NW.	2.562	68	.	.			.	.	

In comparing this table with the Meteorological Summary of 1832, published in the "ARCANA" of last year, the reader will perceive a considerable increase on the year just expired, in the medium temperature of each month.

Number of Days without Rain, but cloudy throughout	74	Number of Days rainy A.M. only	41
,, ,, clear throughout or for the greater part	76	,, ,, rainy P.M. only	39
,, ,, rainy throughout	6	,, ,, snow	7
,, ,, for the greater part fair	48	,, ,, thunder	8

The most violent winds were in February, June, November, and December, and all westerly. From the 16th to the 20th of December inclusive, it blew an unintermitting hurricane. During nearly the whole of that period the rains were heavy and incessant. In some parts of Surrey, as South Brixton, the roads were almost impassable; and in the dwelling houses, the ground floors were flooded to the height of two feet.

The maximum and minimum of temperature are ascertained from a self-registering thermometer, by Ronketti, suspended at an altitude of 30 feet, and facing due north, nearly.

The points in the seven columns on the right hand of the Table, opposite to each month, denote the modification of cloud which prevailed throughout that month; and the name, by which each modification is known to meteorologists, is specified at the top of each column.

RURAL ECONOMY.

Planting Oaks.—So valuable is this tree, that many plans have been adopted in planting and rearing it. Of all these, there is perhaps scarcely any preferable to that followed by the ingenious Mr. Forbes, gardener at Levens, in Westmoreland. Mr. Forbes having found much injury produced by the usual method of planting the oak, by thrusting forcibly into a hole the tap-root, has obviated it, by adopting another. He makes a cut in the root upwards, a little below the place where the root issues from the stem. This slit enables the root to be laid or bent down on the ground when planted, in a horizental position, in the hole made for the purpose. The root, placed in this manner, is then carefully covered over with earth. In planting oaks in the common way, by pushing the tap-root downwards, much injury must necessarily be done to the growth of the young plant. All plants having tap-roots draw their nourishment into them by small fibrous roots. These, acting like as many mouths, suck in the nutritive matters from all quarters, and ultimately throw them into the main root. The main root then conveys the nourishment into the stem and leaves, there to be converted into different substances, sap, bark, and wood. The common manner of planting oaks, by thrusting the tap-root downwards, injures these small fibrous roots. In the operation of this common way of planting, they are pushed upwards, and consequently are diverted from their proper direction, horizontally or vertically. Being so much injured and wounded, they ultimately either die or languish, or dwindle on in a feeble state for awhile; or those that survive the violence they have suffered, retard for a long time the growth of the plantation. No growth of the young plant can be expected until these injured fibres are replaced by new ones. The tap root also being injured by this forcible thrusting into a hole, often has its point broken, or bruised, or "rusted," as it is called. The wounds it has received must consequently retard its thriving for some time. Accordingly, where such a method of planting is followed, numbers of young oaks remain stunted, if they do not altogether die. But Mr. Forbes's plan of managing the root of the sapling oak, in the way described, seems to prevent all these injuries of the old method. He begins planting the oak as early as the middle of November, and continues putting them into the ground until the end of February. And from the moment the spring commences, the young oak, placed under such favourable circumstances, is prepared, with all its fibres uninjured in the planting, to thrive immediately, and to grow vigorously. For more than twenty years Mr. Forbes has adopted this plan. The rapid growth and healthy state of the oak woods at Levens, demonstrate most forcibly the advantages of this method of planting over every other. While, on the contrary, a neighbouring proprietor's oak woods, growing on the same kind of rock, but planted on the old plan, and at the same time with those of Levens, have annually required more or less renewing with fresh plants; but those of Levens have scarcely required a single oak plant to be replaced.—*Quar. Jour. of Agric.*

Destruction of Seed-Corn.—The average produce of the average quality of soil is only seven times the quantity of seed sown. The quantity of

seed sown per acre has hitherto evidently been ascertained by practice alone. The seed has been sown up to the quantity which produced a full crop, and then that quantity had been fixed upon as requisite for the crop; but now we see that one-third of that quantity is sufficient for the crop. Ought we then to sow only the third? Prudence would decide in the negative, till it is ascertained how the loss of the two-thirds arises. That loss in the mean time is of great magnitude. The number of cultivated acres in Great Britain and Ireland amounts to 47,000,000; 30,000,000 of which are under the plough. Two-fifths of the latter, or 12,000,000 acres, are annually under the cereal crops. The average allowance of seed for the three kinds of corn may be stated at $4\frac{2}{3}$ bushels per acre. The quantity of seed annually sown thus amounts to 7,000,000 quarters. If two-thirds of this quantity are rendered unproductive by some agency which has hitherto been uncontrolled, then 4,666,666 quarters of corn are annually wasted! The quantity thus lamentably wasted would support more than 1,000,000 of human beings.—*Ibid.*

Saxony Wool.—To the late King of Saxony, when Elector, is due the merit of having first brought the breed of Spanish Merino sheep into Germany, which has since transfered the valuable trade in fine wool almost wholly from the Spanish to the German soil. From the period of its first introduction until 1814, when Europe once more began to enjoy the blessings of a general peace, this wool was gradually, although slowly, spreading itself over the surface of the kingdom of Saxony; but when the continental trade was thrown quite open, by the events of the short campaign of 1815, and the minds of men were set at rest by the final catastrophe of Napoleon, the Saxon wool dealers began to open a regular trade in the article to England, and they soon discovered the real value of this new branch of German commerce. In the first year, viz.:—

In 1814, there were imported into England only	3,593,146 lb.
1819, ...	4,557,938
1824, ...	15,432,657
1828, ...	23,110,882

This prodigious increase in the demand for German wool naturally excited the emulation of the States lying contiguous to Saxony; and the flock masters of that kingdom carried on, for a considerable period, a very prosperous trade in rams and ewes with the landowners of Silesia, Bohemia, Austria, and other parts, who were desirous of changing the nature of their flocks to this more profitable breed. All the superabundance of grain, which had no external vent to carry it off, was given to the sheep, in order to accelerate their approach to the maximum degree of fineness of which their wool was susceptible; thus actually creating a profitable consumption for their corn, through the eagerness exhibited in England to obtain a superior quality of wool.—*Ibid.*

Bees in Cashmere.—Every farmer in Cashmere has several bee-hives in his house, and in some houses as many as ten. A provision is made for these in building the house, by leaving appropriate cavities in the wall, and which somewhat differ in size, but agree in their general form, each being cylindrical, and extending quite through the wall. The tube thus formed is lined by a plastering of clay mortar, about an inch in thickness, and the mortar is worked up with the chaff or husk of rice, or the down of thistles, which latter is employed for clay mortar in general. The dimensions of a hive are, on an average, about fourteen inches in diameter, and when closed at both ends, about twenty or twenty-two inches in length.

The end of the cylinder nearest the apartment is closed by a round plaster of red pottery ware, a little convex in the middle, but with the edges made flush with the wall by a luting of clay mortar, and the other extremity is shut by a similar disk, having a circular hole about a third of an inch in diameter in the centre.—It does not appear that there is any particular rule for the height of these hives from the ground, as they are sometimes confined to the walls of the lower basement story, generally appropriated to cattle in the farm-houses of Cashmere; others are inserted into those of the first floor, and are frequently in both situations in the same house, as well as the walls of its outbuildings. So great difference exists betwixt the practice ordinarily pursued in Cashmere and in Europe, in respect to hiving new swarms when the honey is taken, that it deserves imitation. Having in readiness a wisp of dry straw, and a small quantity of burning charcoal in an earthern dish, the master of the house, with a few strokes of the point of the sickle, disengages the inner plaster of the hive, bringing into view the combs suspended from the roof of the hive, and almost wholly covered with bees, none of which, however, offered to resent the aggression, or to enter the room. Having placed the straw upon the charcoal, and holding the dish close to the mouth of the hive, he blows the smoke strongly against the combs, but removes the dish the instant the straw takes fire, to prevent it burning the bees, and quenches the flame before he employs it again. Almost stifled by the smoke, the bees hurry out of the outer door with such rapidity, that the hive is cleared of its inhabitants within a few minutes, when the farmer introduces the sickle, cuts down the combs nearest to him, which are secured into a dish previously slidden underneath them, and leaves undisturbed about one-third of the combs. He then replaces the inner plaster, and brushing off hastily a few bees that cling to the combs, though apparently in a state of stupefaction, throws them out of the house.—*Mr. W. Moorcroft, in the Journal of the Royal Geographical Society.*

The Teasel.—The season, 1832, was the most productive in this important article of produce in the West of England ever remembered; and the crops were gathered in the best possible condition.—*Qu. Jour. Agric.*

For Smearing Sheep.—Take 12 Scots pints of tar, add 12 imperial gallons of clear seal oil, 3 imperial stones of potatoes, and 2 lb. of soda. The potatoes are to be neatly pared and scraped, then well washed, boiled on a good fire until the water is imbibed or evaporated, taken off, and finally mashed until they are reduced to a fine pulp. Pour the seal oil and the soda upon the potatoes, stir the whole well together, until the mass is thoroughly incorporated, add one imperial gallon of urine, stir again, and when about the warmth of milk from the cow, pour the whole into the tar. After ten minutes' stirring, the whole will be perfectly incorporated, and the mixture will be fit for use in a few hours after. The expense is 9*s*. With this quantity 72 sheep may be well smeared, so that the expense for each is only three halfpence; whereas in the common way of reducing the tar with butter, and smearing at the rate of three or four to the pint, it cannot be done under 5*d*. or 6*d*. each sheep, provided the necessary quantity of butter be used, which, however, is seldom done, and of course the tar does not wash fairly from the wool.—*Transactions of the Highland Society.*

Poultry.—The comparative value of keep for domestic fowls is as follows:—Geese, 5 per cent; ducks, 7 and a half; pigeons, 10; dunghill fowls, 40; turkeys, and Guinea-fowls, 50.—*Ibid.*

Swing Frame for Cheeses.—New cheese requires to be hardened considerably by gradually drying before it becomes fit for market. For this purpose the cheeses are spread in a single layer on the floor of the cheese-room, and are turned by hand every day, in order to expose each surface alternately to the air. This, on a large dairy farm, is a slow and laborious operation, which, as it devolves on the female servants, sometimes prevents them, in the hurry of business, from paying proper attention to keeping every implement used on the dairy in that degree of order and absolute cleanliness so essential to the good quality of the produce. Another objection to the common method is, that the floor on which the new cheeses are laid soon becomes penetrated with moisture, so that the benefit which each surface of a cheese in succession gains by exposure to air, is in part lost by being placed the next day in contact with the damp floor. A machine of very simple construction, has been recently contrived by Mr. Blurton, of Field Hall, near Uttoxeter, by which these objections are not only completely removed, but the process of drying amazingly accelerated. We extract our present account of it from the last part of the *Transactions of the Society of Arts*, who have confered their large silver medal on Mr. Blurton for the invention. The machine consists of a dozen strong shelves framed together, and having bars nailed from top to bottom of one side to prevent the cheeses from falling out while in the act of turning. The frame is suspended on two strong pivots, one of which is set into the wall of the room, and the other is supported by a strong post. Two catches keep the frame upright, and prevent it from being turned more than half round. By first filling the shelf immediately below the axis of the frame, and then placing the cheeses alternately on the two nearest shelves above that which has been already filled, the preponderance of one side over the other can never be more than the weight of one cheese; the whole power, therefore, required to turn the machine cannot, in any circumstances, be greater than this and the friction of the pivots. The cheeses, in the act of turning, drop on the shelves which, in the former position of the frame, were above them, and having been exposed to a current of air for twenty-four hours previous, have become perfectly dry. Mr. Blurton has had the machine in use for five or six years, and finds that by means of it fifty-five cheeses are turned in the same time which is required for turning two by hand. Three other advantages attend its use; first, that a room thus furnished will hold thrice as many cheeses as when they are laid on the floor; secondly, that the shade afforded by the shelves, together with the current of air which passes between them, has the effect, in hot weather, of preventing excessive sweating, and consequently loss both in weight and quality, as well as diminishing the necessity of rubbing the cheeses; thirdly, the ripening of the cheeses is hastened, so that on an average they are ready for market five weeks earlier than usual.—*Repertory of Patent Inventions.*

Rules for Managing Cottagers' Allotments.—The following plain rules are addressed to landowners and farmers, by the strict observance of which it has been found, from long experience, that the labouring poor may be rendered comfortable and comparatively independent, and the poor rates in almost all agricultural parishes may be made nearly nominal. By the Rev. Joseph Wilton, Minister of Laxton, Northamptonshire:—(1.) *Cottages and Land.*—1. To each cottage apportion, as near to it as possible, one quarter or one-third of an acre of land, at a moderate yearly rent, according to its quality. 2. Do not allow of more cottages

than the extent of the parish really requires. 3. See that the cottages are kept in good repair, and preserved dry, and well white-washed within. (2.) *Labour and Wages.*—1. For really productive labour, always give a labourer good and liberal wages, without any reference to his being married or single. 2. Whenever you can, set the labourers their work by the task, or great. 3. Never allow of rounds-men. 4. Never permit of any part of a man's wages to be paid out of the poor-rate. 5. As the labourer should always receive good and liberal wages for productive labour, so, on the other hand, when the labourer is employed on mere parish work, he should have hard work and short wages, and his work by the task or great. 6. See that the very aged, the sick, and the infirm, are kindly treated. (3.) *Religion, Morals, and Parish Economy.*—1. See that the children of the labouring poor have a christian education, in a well-regulated and conducted school. 2. Enforce by all proper means, a regular attendance of all the people on public worship at the parish church. 3. Allow of no more public-houses than are absolutely necessary. 4. Discourage, in every proper way, all tippling and drinking. 5. Discourage to the utmost degree all lewdness and improvident marriages. 6. Never force a marriage in order to prevent a child being born illegitimate; but put the law fully in force against the mother, by committal to prison, if she make the illegitimate child chargeable to the parish. 7. Purchase fuel in summer, to be sold out to the labouring poor at a cheap rate in winter. 8. Patronize and promote Clothing Societies. 9. Endeavour to influence the poor to unite in Friendly Societies, and to put whatever money they can save in some Savings Bank. 10. Administer the poor laws firmly and rigidly.—*Quarterly Journal of Agriculture.*

The Application of Steam to Agricultural Purposes is said to have lately called forth a powerful and effective engine in France; and it has, at the same time, produced a steam-digging machine in England. This engine, an imperfect model of which we saw three years ago, has lately been so far improved, that a patent has been taken out for it, by Mr. Philips. It will be found figured and described in Gordon's *Journal of Locomotion*, for February, 1833. We have lately seen the model of another machine, which may be applied to the same purpose, and, as it appears to us, with much greater chance of success. At one operation, it could be made to plough, pulverize, roll, sow, and harrow a breadth of 10 ft. or 12 ft., at the rate of five or six miles, and, consequently, between seven and eight acres per hour. The machine might, no doubt, be impelled at double that rate; but it is questionable whether at such a velocity the work of sowing could be properly performed. The present, however, is not the time for bringing out such a machine in England, where the farmers, in most districts, are obliged to take down and conceal the wheels of their threshing machines, if these have not been already burned by their labourers.—*Gardener's Magazine.*

Victoria Wheat.—Of the wheat of the neighbourhood of Victoria, a village in the province of Caraccas, which Humboldt, in his *Personal Narrative*, p. 104—107, has noticed as being very productive, and as ripening, in Victoria, in seventy or seventy-five days from the sowing, Dr. Hamilton, 15, Oxford Place, Plymouth, has received seeds from Sir R. K. Porter, and distributed them in small quantities to various individuals in Britain. We are altogether doubtful of "its coming to maturity" in this climate "in the singularly short space of time spoken of by Humboldt;" and as the grains "appear smaller, and of a darker colour,"

than those of our own wheats, we scarcely at all participate in Dr. Hamilton's sanguine expectations respecting it: still this is no reason why every experiment should not be tried. Dr. Hamilton, after soaking two grains for twenty-four hours, in a solution of oxalic acid, sowed them on August 26, and on August 29, he wrote—"They are now above ground, in a pot in one of my windows, and I am in the hope of their perfecting their crop in November." Dr. Hamilton conceives the possibility of three crops in a year being attained, "even in this cold country, in favourable seasons and situations."—*Ibid.*

Culture of the Chiccory.—This plant is extensively cultivated in many parts of Russia, in Germany, Flanders, and other parts of the European continent, for its roots, which are used as a substitute for coffee; and it may not be very easy to account for the inattention to the culture of so useful a plant by the British farmer, it being only known in this country, though it is a native, as an antiquated kind of salad. By Young it is said to form a substitute for clover; by others that the plant rises from one to three feet high, and if raised by being mixed with other seeds in the same manner as clover, intended for hay as pasturage, it may not exceed that height, nor is it often found in its natural state above two or three feet in height. It should be remarked here, that *Chicorium Intybus* has a fusiform sort of root; and it is a well known fact, that the luxuriance of stem and foliage of such plants is in proportion to the thickness and strength of the root. Judicious culture, therefore, in the early stages of its growth, is necessary to secure future luxuriance. Let the seeds be sown in a bed early in March, and when the leaves are about three inches in length, which they will be by the beginning of May, let them be planted out in well pulverized ground, in rows 9 inches apart, and 6 inches from plant to plant in the rows. The weeds must be kept down by hoeing the first season, but no farther trouble is necessary for seven or eight years, till the plants begin to show symptoms of decay, when they may be thrown out, the ground cleared of the roots, and laid under a fresh plantation. When this plant is allowed to stand too close, as in mixture with grasses or clover, the root is small and the stem small, short, and wiry. Under the above mode of treatment, even in ordinary soils and with little manure, the stems will rise to 6 or 7 feet in height, and they will be as close as to admit of being covered with foliage, the stem varying from three-eighths to five-eights of an inch in diameter near the ground, and replete with a rich nutritive milky juice. This succulence is retained in full vigour till the flower-buds begin to appear, when the stems should be cut out near the ground, and carried to the byre or pig-sty, where even at the first trial they are devoured with avidity. It will be readily observed, that as the chiccory is in some sort perennial, its culture cannot be attempted in a rotation of cropping, and it must therefore be confined to some steep declivity or corner of a field inaccessible to the plough. On waste corners, near large towns, no plant cultivated in this climate will bring the cowfeeder nearly an equal return with the chiccory; it should also hold a prominent place in the garden of every cottager in the kingdom, whether to be used as coffee by the family, or as green food by the cow or pig. Were its culture general in Ireland, it would soon prove of more substantial advantage to the labouring classes in the Emerald Isle, than many of the political panaceas of the day.—*Quarterly Journal of Agriculture.*

Cobbett's Indian Corn.—In situations where the Indian corn will answer, it will be found an excellent fallow crop, as no one will admit of

such close tillage as it; neither is it so exhausting as potatoes, Swedish turnips, beet root, or cabbage. It is very delicate when in the seed leaf; and, should never be sown or planted earlier than the middle of May, for if a few chilly nights come, when in this state, its growth will be much retarded, if not destroyed. The best manner of cultivating it is in rows, 30 in. or 3 ft. asunder, and the plants from 6 in. to 12 in. asunder in the row. The seed ought to be sown as thick in the row as beans; and when the plants are about 3 in. high, they should be thinned out to the proper distance, which ought to be regulated by the richness or quality of the soil. By these means, there is sure to be a sufficient number of good plants to stand for a crop; except there be a total failure, and then the land will be ready for turnips. It is folly to talk of sowing no more seed than you intend to have plants upon the land.—*Gardener's Magazine.*

Cultivation of Indian Corn.—By Mr. Towers.—The soil should be, in every case, a sandy loam, light and friable in its texture, and abounding with vegetable manure, such as leaf-mould, decayed weeds, or well fermented farm-yard dung. The season for sowing is between the third week of April and the middle of May, choosing fine weather, and a pulverizable state of the ground. The seeds are to be sowed in drills, one yard apart, not deeper than one inch, if the ground be of a binding quality, not more than an inch and a half in a light and rich soil. After sowing they should be covered, and the surface made smooth and even, by beating it lightly with the back of the spade. If the cultivator hesitate to plant an entire plot with the corn, he may previously sow long-pod or other beans in rows, five feet apart; and, in the season, the rows for the Indian corn may be made in the intervening spaces, so as to alternate with, and be two feet and a half distant from the rows of beans: in average seasons, both crops may be expected to be off the ground about the same time in the succeeding autumn. Whatever be the plan adopted, I earnestly recommend the experimenter to set his rows in a direction to point north and south, so as to command the utmost influence of solar light at the mid-day hour, and also to select a full and open exposure. When the young plants have grown five inches, a cautious but deep hoeing ought to be given close to them, and this should be repeated when they have attained the height of a foot. In the mean time, any blanks may be filled up from a small reserve bed, set very thickly for the express purpose. Here, however, I would remark, that although Indian corn will bear transplanting, it will thereby always be dwarfed, unless the plants be lifted and replaced without disturbing the roots; hence, therefore, a safer method of preparing surplus plants would be to sow the seeds in pots (forty-eight size), one in each, at the time of forming the drills, and then, when the blanks are to be filled, to turn out the balls entire, in the places where the deficiencies occur. When the plants have advanced to the height of two feet, the spaces between the rows should be digged to within six or seven inches of the plants, but carefully, so as not to mangle the larger roots; and, finally, when the ears begin to appear, the stems ought to be well earthed up to the height of four or five inches on each side. In August, if the season be propitious, the ears of corn will become fully enlarged, the grains of a palish buff colour, and replete with a farinaceous milky fluid: in this state they will be in perfection as a dinner vegetable, subsequently they begin to ripen in succession; the integuments become brownish, arid, and semi-transparent; the grains change to a clear bright yellow or rich chestnut colour, and they should be gathered as often as these appearances of maturity are visible.

The varieties that I cultivated last year (1832) were, first, the early dwarf yellow, "Cobbett's," from my own seed raised in 1831, plants four feet high, each bearing from two to five ears. These generally comprised ten or twelve ranks, each of from twenty to twenty-five seeds. A good cob weighs from three to four ounces when perfectly dry, and measures in length about five or six inches, and in girth, at medium, four inches and a half. Second, the early brown. This ripens with equal facility and certainty as the yellow, but the ears, though perfect, are somewhat smaller; seeds the same in number, but not so large. Third, a large yellow corn. This, I presume, is a partly naturalized product of the "early golden yellow;" it ripens well, but the ears are not so perfectly formed, and the apex is sometimes defective. It requires the acclimated hardihood of the two others, and hence I mean to hybridize it, if I can cause the two varieties to bring their flowers to maturity at the same time. A fair-sized ear of this variety measures, in length, from seven to eight inches; in the girth, four or five inches; and weighs from four and a half to six ounces.—*Farmer's Magazine.*

Mole Trap.—The contrivance is a fall-trap, made by a square piece of wood or trough, the hollow in the inside about three inches diameter in the square, made of four pieces of wood about three eighths of an inch thick; the whole of the trough being about two feet long. In the centre of this a movable bit of wood is fixed, or rather worked on a strong wire, which, as the animal passes over it, lets him fall into the trap, from which there is no return. To this trough is fixed in its centre, by a willow twig, a box (well planed within), much like a microscope box in form, about eighteen inches deep, and about four inches diameter in the clear at top.—*Gardener's Magazine.*

GARDENING.

Cultivation of Strawberries.—Supposing that strawberries are to be planted, the preparation of the ground claims the first attention. A spot, about ten yards square, not amounting to three falls of ground, will surely not be grudged for the production of this luxury. In the end of autumn, let fourteen barrowfuls of dung, which is about an ordinary cart-load, be carted to the place, open a trench on one side about fifteen or eighteen deep, if the soil permit it, have it all trenched over to an equal depth, mixing the dung intimately with the soil in the course of the operation. Recent horse-dung may be applied where the soil is of a cold or stubborn nature, and cow-dung, not much rotted, where the soil is light and sandy; fill in the last trench with the earth taken out of the first, and leave the surface of the whole as rough as possible, to pulverize with the winter frosts. Early in March dig the ground over a spit deep, breaking it well, and leaving it smooth on the surface. The next is the selection of plants, and on this much of the future success of the crop will depend. The following sorts will be found very prolific, and of easy culture. The Groves-end Scarlet is early ready, amazingly prolific, and excellent in quality. This berry makes a beautiful preserve. Keen's Seedling is a dark-coloured large berry, bears well, and is a general favourite; it is ripe soon after the Groves-end Scarlet. The Bostock strawberry succeeds Keen's

Seedling, the first ripe being about a week later; it is, when well exposed to the sun, as all straberries should be, of a light scarlet colour; its principal merit is the heavy crop it bears. The old Chili is also a hardy plant, and a full bearer. Many other sorts might be mentioned, such as Bishop's Orange, Wilmot's Cockscomb, &c. Having the ground prepared, and the plants brought forward, the rows should be marked two feet apart, the Groves-end Scarlet should be planted about a foot, and the other sorts about fifteen inches from plant to plant in the row; at this rate, four hundred plants will fill the spot. The ground should be kept clear of weeds throughout the summer months. Some advise the runners to be frequently pinched off in summer, others suppose they prove rather beneficial than otherwise to the mother plant, in the early period of their growth; but all agree that it is necessary to remove them in the end of autumn.

As to digging between the rows in winter, practical men are not altogether agreed; if digging is at all resorted to, the ground should only be stirred two or three inches on the surface, as deep digging must injure the roots, and hurt the fruitfulness of the plant. Little fruit will be forthcoming the first season, except a few on the Groves-end Scarlet and Keen's Seedling. The future crops for the three following years should average about forty imperial or Scot's pints yearly, if the ground and plants are managed as above directed. As the ground will be exhausted in four years, it will be necessary to make plantation in proper time, for a succession; and when the fourth crop of fruit is removed, the ground should receive what is termed "a half trench," laying the strawberry plants with about an inch of the surface-earth pared off in the bottom of the trench, to be covered with a deep tramp of soil, left rough for a few weeks, when some dung may be pointed in, and the ground laid under a crop of winter vegetables.—*Quarterly Journal of Agriculture.*

Irrigating Gardens by Tanks or Ponds.—The garden of Thomas A. Knight, Esq. is supplied with water by springs, which rise in a more elevated situation, and thus afford him the means of making a small pond, from which he can cause water to flow over every part of the garden whenever he wishes. He thus irrigates his strawberry beds when in flower, and plants of other kinds, throughout the summer. A stream is caused to flow down the rows of celery, brocoli, &c., with very great advantage. But the most extensive and beneficial use made of it is, to water his late crop of peas. By this means the ill effects of mildew are almost wholly prevented, and the result is a good supply of peas throughout October. When water is delivered in the usual quantity from a watering pot, its effects for a short time are almost always beneficial; but if water be not continued regularly, injurious consequences frequently follow, for the roots of plants extend themselves only superficially, and the plants consequently become more subject to injury from drought than they would have been if no water had been given to them. When, on the contrary, the soil is irrigated in the manner above recommended, it is wetted to a great depth; and a single watering, once in eight or ten days, in almost all cases, fully sufficient.—*Trans. Horticultural Society.*

Oxalis Crenata.—The tuber of the Oxalis crenata was brought from South America by Mr. David Douglas, and was planted in 1831, by Mr. Lambert. One of the tubers obtained from Mr. Lambert was planted in a pot in the green-house, in the end of April last, and, in the month of

May the pot was removed to the flower-garden and broken, and the parts removed. It was first planted in the green-house as a security against frost; but it appears to have been unnecessary, as the plant has stood the frost remarkably well, and the leaves, on the 5th instant, before the tubers were dug up, were quite green. The tuber planted was less than an ounce in weight, and the tubers produced were ninety in number, and weighed altogether upwards of 4lbs. They were in a space, the diameter of which was 9 in., and the depth 6 in. The stems were between twenty and thirty in number, succulent, and of a reddish colour. The flowers appeared in August, and consisted of five petals, crenate at the edge, and of a yellow colour. The leaves are trifoliate, the leaflets are inversely heart-shaped. The experiment of cultivating this tuber may be considered as hitherto very successful; and when we consider that the common potato was long confined to gardens, producing roots which were exceedingly small, and was far less promising than the Oxalis crenata at present appears; we may reasonably anticipate that it may prove a valuable addition to our culinary vegetables, and that by skilful cultivation, the tubers may be greatly increased in size.

Varieties of Potatoes.—The following is a statement of the produce of 20 yards of six varieties of potatoes, attested by Mr. Scott of Wooden:

White Kidney,	.	..	..	1	bushel	2	pecks.
Pink Kidney,	..	..	..	1	..	1	
American Early,	..	..	..	1	..	0	
Ash-leaf,	..	..	..	1	..	2	..
London Particular,		..	.	1	..	2	..
Prince of Wales,	..	..	..	2	..	0	..

Trans. Highland Society.

To produce Two Crops of Kidney Potatoes on the same Ground in the same Year.—In taking up the first crop, bury the tops in the trench by turning the earth between the rows upon them; the ground is then ready to plant again. At the end of March, plant the first crop, and the second about the middle of July.—*The first crop.* It is well known to growers of the ash-leaved kidney, that it is difficult to prevent its exhausting itself previously to the time of planting it, and that, if seed potatoes of it are allowed to remain too long in the pit, frequently not one-third of them will grow. To prevent this, put them into the pit about Christmas, and take them out the latter end of February or beginning of March.—*The second crop.* Those intended for the seed potatoes of the second crop, spread thinly on the floor of an outhouse, where there is a fine current of air. This treatment so much checks the growth of the sprouts, that these do not become more than one inch long, and are individually furnished with a cluster of roots. Plant the potatoes with the shoots upon them in this state; and, in planting them, guard carefully against breaking off any of the shoots. Those potatoes produced in the second crop are the fittest to procure for the next year's planting; as, when housed or pitted, they are less prone to exhaust themselves by sproutiness than are those of the first crop. During the latter part of the first crop being taken up, it would be well not to bury the unripe tops, as they are apt to produce some minute potatoes to the detriment of the second crop.—*Mr. John Denson, sen. in the Gardener's Magazine.*

Fecundity of the Onion.—It was stated that a gentleman in Lancashire has raised this season (1832,) 8,000 ounces of onions from twelve ounces of seed. Mr. Crossley, the engineer of the Macclesfield canal, residing

at Bollington, having seen this statement, was induced to weigh his crop, when he discovered, that from two ounces of seed, the produce was the amazing quantity of 2,496 ounces or 156 pounds, being nearly double the produce of the former, in proportion to the quantity of seed sown.—*Repertory of Patent Inventions.*

Plants in Hothouses. By Professor Daniell.—Tropical plants require to be watered at the root with great caution, and it is impossible that a sufficient supply of moisture can be kept up from this source alone. There can, however, be no difficulty in keeping the floor of the house and the flues continually wet, and an atmosphere of great elasticity may thus be maintained in a way perfectly analogous to natural process. Where steam is employed as the means of communicating heat, an occasional injection of it into the air may also be had recourse to; but this method would require much attention on the part of the superintendant, whereas the first cannot easily be carried to excess. It is true that damp air, or floating moisture of long continuance, would also be detrimental to the health of the plants, for it is absolutely necessary that the process of transpiration should proceed; but there is no danger that the high temperature of the hot-house should ever attain the point of saturation by spontaneous evaporation. The temperature of the external air will always keep down the force of the vapour; for as in the natural atmosphere the dew-point at the surface of the earth is regulated by the cold of the upper regions, so in a house the point of deposition is governed by the temperature of the glass with which it is in contact. In a well ventilated hot-house, by watering the floor in summer, we may bring the dew-point within four or five degrees of the temperature of the air, and the glass will be perfectly free from moisture; by closing the ventilators, we shall probably raise the heat 10 or 15 degrees, but the degree of saturation will remain nearly the same, and a copious dew will quickly form upon the glass, and will shortly run down in streams. A process of distillation is thus established, which prevents the vapour from attaining the full elasticity of the temperature. This action is beneficial within certain limits, and at particular seasons of the year; but when the external air is very cold, or radiation proceeds very rapidly, it may become excessive and prejudicial. It is a well known fact, but one which, I believe, has never yet been properly explained, that by attempting to keep up in a hot-house the same degree of heat at night as during the day, the plants become scorched. From what has been premised, it will be evident that this is owing to the low temperature of the glass, and the consequent low dew-point in the house, which occasions a degree of dryness which quickly exhausts the juices. Much of this evil might be prevented by such simple and cheap means as an external covering of mats or canvass. The heat of the glass of a hot-house at night, does not probably exceed the mean of the external and internal air; and taking these at 80° and 40°, 20° of dryness are kept up in the interior, or a degree of saturation not exceeding 528°. To this, in a clear night, we may add at least 6° for the effects of radiation, to which the glass is particularly exposed, which would reduce the saturation to 434°, and this is a degree of drought which must be nearly destructive. It will be allowed that the case which I have selected is by no means extreme, and it is one which is liable to occur even in the summer months. Now, by an external covering of mats, &c. the effects of radiation would be at once annihilated, and a thin stratum of air would be kept in contact with the glass, which would become warmed, and consequently tend to prevent the dissipation of the

heat. But no means would of course be so effective as double glass, including a stratum of air; indeed, such a precaution in winter seems almost essential to any great degree of perfection in this branch of horticulture. When it is considered that a temperature at night of 20° is no very unfrequent occurrence in this country, the saturation of the air may, upon such occasions, fall to 120°, and such an evil can only at present be guarded against by diminishing the interior heat in proportion. The present method of ventilating hot-houses is also objectionable, upon the same principles which I have been endeavouring to explain. A communication is at once opened with the external air, while the hot and vaporous atmosphere is allowed to escape at the roof; the consequence is, that the dry external air rushes in with considerable velocity, and becoming heated in its course, rapidly abstracts the moisture from the pots and foliage. This is the more dangerous, inasmuch as it acts with a rapidity proportioned in a very high degree to its motion. I would suggest, as a matter of easy experiment, whether great benefit might not arise from warming the air to a certain extent, and making it traverse a wet surface before it is allowed to enter the house. There is one practice universally adopted by gardeners, which is confirmatory of these theoretical speculations: namely, that of planting tender cuttings of plants in a hot-bed, and covering them with a double glass. Experience has shown them that many kinds will not succeed under any other treatment. The end of this is obviously to preserve a saturated atmosphere; and it affords a parallel case to that of Dr. Wells, of the anticipation of theory by practice. The effect of keeping the floor of the hot-house continually wet, has been already tried at the Society's garden, at my suggestion, and it has been found that the plants have grown with unprecedented vigour; indeed, their luxuriance must strike the most superficial observer. But there is a danger attending the very success of this experiment, which cannot be too carefully guarded against. The trial has been made in the summer months, when the temperature of the external air has not been low, nor the change from day to night very great. In proportion to the luxuriance of the vegetation, will be the danger of any sudden check; and it is much to be feared, that unless proper precautions are adopted, the cold long nights of winter may produce irreparable mischief. The principles which I have been endeavouring to illustrate should be, doubtless, extended to the pinery and the melon frame, in the latter of which a saturated atmosphere might be maintained by shallow pans of water. An increase in the size of the fruit might be anticipated from this treatment, without that loss of flavour which would attend the communication of water to the roots of the plants. I have but few additional observations to offer upon the artificial climate of a green-house. The remarks which have been made upon the atmosphere of the hot-house are applicable to it, though not to the same extent.—*Abridged from the Horticultural Transactions.*

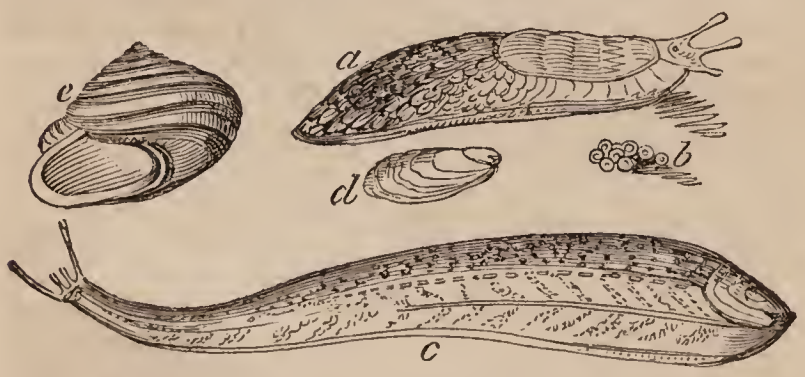
Climate on Vegetation.—To cultivate exotic plants well, every gardener should have seven or eight different houses, each of which should be devoted to plants requiring a particular climate. This would render collections of plants much more interesting than they are at present; since, from the power that all plants possess of accommodating themselves to circumstances, those cultivated in stoves in Britain are in a decidedly artificial state, and retain but few of their original habits. Many of the peculiarities of the different climates may be easily imitated: where excessive light is required, the houses should have iron framework, and white clear glass; where less light is wanted, wood framework might be

employed ; and, for those plants which require shade, to wooden frames might be added green glass, or netting, or climbers, or even wooden shutters. It is not more difficult to give proper proportions of air and moisture. Vapour is easily produced for those plants which require a suffocating moist heat, by throwing water on a heated floor. In this manner, with such additions as will, of course suggest themselves to an experienced gardener, the native climates of almost all kinds of plants may be correctly imitated ; but it can never be too often repeated, that all will be comparatively useless unless the plants are allowed proper periodical rests. The taking up of tulips and hyacinths, and of the roots of georginas, &c., affords an illustration of the same principle. Nearly all foreign bulbs die after the first season, if left to winter in the ground. —*Lindley.*

Tulip Fancying.—We have as much right to laugh at an old booby, who, over his rusty coin cabinet, feasts his eyes on his fifty-guinea old coppers and sixpences, or at the silly buyer of daubed canvass at a thousand guineas a yard, or at the madman who gives a thousand pounds for a horse, to break his own neck with, as they have at the "fool who gives twenty or fifty guineas for a tulip."—*Horticultural Journal.*

A Metropolitan Society of Florists and Amateurs has been established, and held its first meeting at the Crown and Anchor Tavern on the 17th of June. The attendance was neither so good, nor were the articles so numerous, as we have no doubt they will be when this Society becomes better known. The Queen is said to patronize this Society and to have offered a piece of plate annually for the best show of tulips.—*Gardener's Magazine.*

Shell Slug.—The cut represents the shell slug, Testacellus Maugei of *Ferussac,* which exists, or recently did exist, at Bristol. It is noticed in the Encyclopædia of Agriculture :—" The shell slug, Testacellus Maugei (*c*) is a native of Teneriffe, and has likewise been found in several parts of France and Spain : it has recently been discovered in some gardens, near Bristol, by Mr. Miller, of that city. It is a highly curious animal, remarkable for feeding upon earth worms ; and may therefore be beneficially introduced into such gardens as are overstocked with that otherwise useful animal. It is readily distinguished from all other slugs in this country [T. Scutulum seems here to have been forgotten] by having a thin oval shell (*d*) affixed to the hinder part of its body. The figures accompanying Testacellus Maugei, represent (these three having been inadvertently engraved.) Limax agrestis : *b,* eggs of Limax agrestis ; *e,* shell of Helix nemoralis. Mr. J. D. C. Sowerby conceives that T. Mauguei is not indigenous to Britain, but that the specimens at Bristol were imported, probably by accident, along with plants from Teneriffe or elsewhere : and he believes that they have been since protected in a green-house, and their preservation attended to.—*Gardener's Mag.*



Chinese Roses may be propagated from single Buds, as Grape Vines are propagated.—The single bud, with a quarter of an inch of the stem both above and below it, is placed just under the soil, under a bell glass; the leaf stalks and leaves standing upright as in a cutting. A single bud of Rosa semperflorens sanguinea was planted on July 26, and on Sept. 8. the bud had grown nearly four inches, and a blossom bud was formed on Oct. 9. it was six inches high, and side shoots were being produced.—*Gardener's Magazine.*

Directions for taking Impressions from Plants, on Cotton, Silk Lawn, Muslin, or Linen.—The colours, which may be obtained from any chemist's must be prepared with cold-drawn linseed oil. The balls are to be made of soft leather, and stuffed with wool. If the impressions be taken on paper, they may be coloured afterwards with any water-colour.—*Gardener's Magazine.*

Directions for making the Colours.—Lampblack or ivory black makes black; king's yellow or orpiment makes yellow; Prussian blue and king's yellow, added together, make green; rose pink or drop lake makes pink; smalt or Prussian blue makes blue; vermilion or carmine makes red. A thimbleful of roche alum, added to one ounce of any of the above colours, will make them stand washing and wearing.—*Gardener's Mag.*

Covent Garden Measures.—Mr. Bevan has communicated the following approximations. (See *Arcana*, 1833. p. 278.) to ascertain the capacities of these measures. His results are—

2 sieves	=	1 bushel.
4 half sieves	=	1 bushel.
8 quarter sieves	=	1 bushel.
12 large punnets	=	1 bushel.
16 second punnets	=	1 bushel.
32 third punnets	=	1 bushel.
48 least punnets	=	1 bushel.

In other words, the sieve may be considered equal to half a bushel.

Half sieve	=	1 peck.
Quarter sieve	=	1 gallon.
Second punnet	=	1 pottle.
Third punnet	=	1 quart.
Least punnet	=	1 pint and a third.

Philosophical Magazine.

MISCELLANEOUS ARTS.

Filtering Machine.—Take a large flower-pot, and put either a piece of sponge or some cleanly washed moss (Sphagnum is to be preferred) over the hole at the bottom. Fill the pot three fourths full with a mixture of equal parts of clean sharp sand and charcoal broken into pieces about the size of peas. On this lay a piece of linen or woollen cloth, large enough to hang over the sides of the pot. Pour the water to be filtered into the basin formed by the cloth, and it will come out pure through the sponge in the bottom. The cloth must be frequently taken out and washed, as must the sand and charcoal, and the piece of sponge or moss in the bottom. The larger the pot, the more complete will be the filtration. The charcoal is easily procured, by burning a few pieces of wood in a slow fire. This is the cheapest description of filter which we know of.—*Gardener's Magazine.*

Mr. Busby's Method of circulating Water, hot or cold, by the Aid of Machinery.—This method is described at length in the *Repertory of Patent Inventions* for September, vol. iv. new series, p. 137. The circulation is effected by an apparatus which may be compared to the wheel of a winnowing machine, and which is fixed on a perpendicular axis within the boiler (which must be circular,) with its axis as nearly as possible over the end of a pipe which reaches from the circumference to the centre of the boiler. There is another pipe, which reaches no farther than the circumference. These two pipes may descend or be conducted to any distance, being united at their farther extremity so as to form only one pipe. The whole being then filled with water, the fan or circulator is made to revolve, by the action of the smoke and hot hair of the chimney-flue, upon the fans of a common smoke-jack; and the result is, a rotatory motion communicated to the fluid in the boiler, the centrifugal force of which will so act against the fluid in the pipe terminating in the circumference, as to force the water down it, while it draws it out of the other. It is evident that, by this apparatus, either hot or cold water may be circulated with equal ease; the circulation depending entirely upon the centrifugal force, and the orifice of one pipe being in the centre, and the other in the circumference, of the boiler. The result is certainly such as would not easily have been anticipated. "To prove the efficacy of his invention, Mr. Busby has had an apparatus, on his principle, fixed on the premises of Mr. Eckstein, ironmonger, in Holborn; and, on the 9th of August, a numerous meeting of engineers and gentlemen of science took place, to witness its performance. The furnace is situated in a workshop on the second floor: and the heated water, urged by the circulator, passes through inch pipes to a receptacle in the open shop on the ground-floor, having descended 21 ft. below the furnace. The experiment succeeded completely, and gave universal satisfaction. Mr. Busby considers his invention of general application; for besides forcing the hot water downwards, an object never before accomplished, he causes so rapid a circulation in the ascending and level pipes, as to be enabled to employ tubes of much smaller bore than are now used. He can, besides, make water ascend and descend again about doors and windows, pass beneath floors; and, in short, he can carry his pipes in any direction whatever, without sensibly impeding the circulation of the hot fluid." In heating dwelling houses, and in cooling or heating liquors in manufactories, it is evident that this most ingenious invention may be turned to good account.—*Gardener's Magazine.*

Lighting Dwellings with Gas.—The cuts explain a small gas apparatus which was constructed, and has been kept in use for two years, for lighting a small private house in the country, remote from gas-works, properly so called. The first attempt at this apparatus originated in the idea of placing a retort in the kitchen fire. It was soon found that the heat of an ordinary fire is insufficient to decompose the coal in the retort, so as to yield the full quantity of gas that might be expelled from it. It was also found to be very inconvenient in other respects. Recourse was now had to the erection of a small house to contain the whole apparatus. The dimensions of this building were 12 feet long by 9 feet wide, and 9 feet high. The apparatus now to be described is represented in the two annexed cuts. Of these Fig. 1. is a ground plan of the house and apparatus, and Fig. 2. being a prospective view of the same, in which the front wall of the house is supposed to be removed; the same letters of reference applying to both figures. A, is the furnace with the retort;

the latter is 15 inches long, and 5 inches diameter of cast iron, and contained a charge of 8 lb. of coal. To the upper side of the retort, and near its mouth, is joined an iron pipe B, about 1 inch in diameter, left open

Fig. 1.

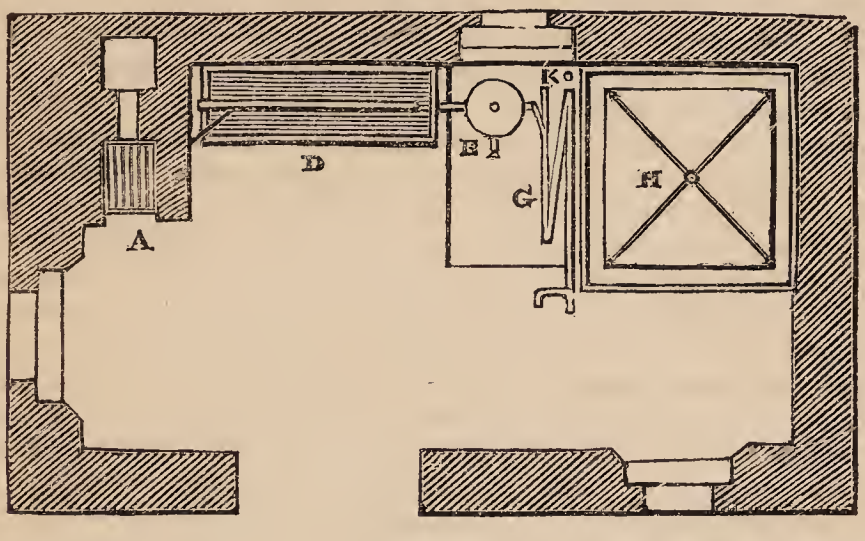
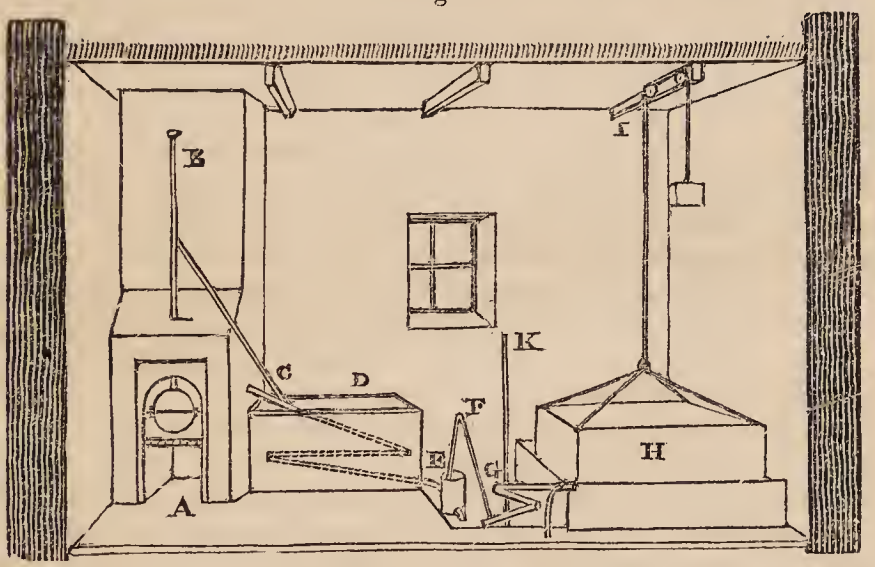


Fig. 2.



at top, for the purpose of cleaning off the crust of tar that forms on the inside, but while in operation the opening was closed with a wooden plug. The sloping pipe C conveys the gas onward to the cooler or condensing vessel D. This is an oblong trough, which being kept full of cold water, and the pipe which thus conveys the gas being made to traverse the trough in the direction of the dotted lines, having at the same time an inclination towards the tar cistern. This retardation and cooling promotes the deposition of the tar and watery parts, which are borne forward by their own gravity along the slopes of the pipe, while the gas thus separated is pushed onward by the pressure from the retort, until they arrive in the cistern E. The tar and water are deposited in the bottom of this vessel, which is air-tight, except by the insertion of the bent pipe F, by which the gas is allowed to pass off towards the purifying vessel. The tar cistern is also furnished with a plug in the bottom, by which the liquids can be drawn off when they accumulate. The purifying vessel G is composed of three inclined pipes, joined as in the figure; these are

open at top and bottom, but fitted with plugs for the convenience of filling and discharging the purifying liquor. This vessel is filled about two-thirds full of slaked lime and water brought to the consistency of thin cream, and the gas being forced through this by the pressure from the retort, it is deprived of the sulphur with which it was combined. The gas now passes through the small pipe connected with the upper end of the purifier, and enters the gasometer H from below. The gasometer is a vessel in which the gas is stored up for use. It consists of two parts, the tank and the gasholder: the tank or lower part is filled with water, and the gasholder, which is an inverted vessel, is a few inches less in diameter than the tank, to give freedom to its motions within the other. The gasholder is suspended by a rope or chain, over the pulleys attached to the beam I, and balanced with a weight attached to the rope. The induction-pipe, after leaving the purifier, descends, and entering through the bottom of the tank, rises again in the inside of the gasholder, till its extremity is an inch or two above the surface of the water. The end of the pipe is here furnished with a cup which constitutes a water-valve, allowing the gas to enter, but preventing its return. The induction-pipe is placed in a manner similar to the last, passing through the bottom of the tank, and rising again on the outside as at K, where it is furnished with a stop-cock, and from this point the branch pipes can be carried to the apartments that are to be lighted.

From the way in which this apparatus was erected, even an approximation cannot be made to the total expense, but, exclusive of the house and the gasometer, the actual outlay amounted only to 2*l.* 7*s.* The gasholder being a cube of 3 feet, it contains 27 cubic feet of gas, which supplied three single jet-burners. The retort was usually charged with 8 lb. of coal, and 8 lb. more were required for the furnace to work off this charge, which produced 27 cubic feet of gas, at the small cost of three halfpence. This quantity supplied the three burners for a period of six hours, hence the cost of one light for six hours is one halfpenny.

The apparatus here described is exceedingly simple, and very well adapted for an establishment on a small scale; but it may be proper to remark, that, in extending it, some deviation would be advisable. In the first place, the crude gas should pass the tar-cistern before entering the condenser; and if, as should always be the case, the cistern is placed at a considerable distance from the retorts, a great part of the tar is deposited during its progress thither. Again, one of the best condensing apparatus is a train of pipes, set on end, and connected at top and bottom alternately, so as to form a continuous course for the gas, and arranged so that the tar will always run towards the tar-cistern. The purifier may be constructed in a variety of ways, and these will vary also as the lime is employed in the wet or the dry state. The gasholder should be always made of sheet-iron, and of a cylindrical form. The tank may be built of stone or of cast-iron, wood being the most objectionable material, from its liability to decay in such situations. When gas is used regularly, and properly attended to, a single jet-burner consumes one cubic foot per hour, emitting a light equal to three or four tallow-candles of six in the pound.—*Quarterly Journal of Agriculture.*

Brewing in England and Scotland.—There were 216 brewers in Scotland last year, of which above 33 are in the Edinburgh collection. Argyll has only 1. There are 17,070 licensed victuallers in Scotland, which is 1 for every 123 persons, young and old, in the country; and though grocers who sell beer are evidently included with innkeepers, the propor

tion is still very great. England, which is a *thirsty* country, rejoices in 50,800 victuallers, and 30,000 "persons licensed for the general sale of beer," making an aggregate of 81,700 retailers of beer, which is 1 for every 170 souls. England has 1,753 brewers, of whom 108 are in London. Of the retailers of beer, 37,000, or nearly one-half, brew their own beer. In Scotland, only 318 out of 17,070, or 1 in 57, brew their own beer. In Scotland, 990,000 bushels of malt were used for brewing in all the 16 collections, of which *one-tenth* was used by the licensed victuallers; 432,000 bushels were used in the Edinburgh collection; 62 bushels served the two collections of North and South Argyll, containing 100,000 souls. In England, 25,800,000 bushels of malt were consumed in the manufacture of beer, 13,800,000 by the brewers, and 12,000,000 by the victuallers or other retailers. In Scotland, the malt brewed is at the rate of four-tenths of a bushel for each person; in England, it is 1¾ bushel. Ireland consumed 1,540,000 bushels of malt in her breweries, which is about two-tenths of a bushel for each person. Of brewed liquor, *one* Englishman drinks as much as *four* Scotchmen, or *nine* Irishmen. In 1831, there were 928,000 bushels of malt used for brewing in Scotland, of which 834,000 were used by the brewers, the rest by victuallers. In 1830, the Scotch brewers consumed 740,000, but the paper from which this is taken does not mention the victuallers. The increase in the quantity of malt used by the brewers since 1830 seems to be about *one-fifth*. —*Quarterly Journal of Agriculture.*

Caoutchouc Manufactures.— On June 14, at the Royal Institution, Mr. Brockedon gave a conversation "On the Application of Caoutchouc to different Manufactures, particularly to elastic Web." The lecturer stated, that although his object was to explain the application of caoutchouc to elastic fabrics, yet, perhaps, it would be interesting to give a short account of the early knowledge of the material in this country; for although it has been known here about one hundred years, yet very little of its useful properties were discovered till within the last ten to fifteen years, when Mr. Hancock took out his patent for applying it in its elastic character, and used it as springs for gloves and a variety of other articles, by sewing threads of the elastic gum between two surfaces, as described in his specification. A patent was also taken out in the name of Mackintosh, for placing a thin layer of caoutchouc between two thicknesses of cloth, and thus rendering the same waterproof; since which other patents have been taken out with reference to this subject.

For the first knowledge in Europe of the source of caoutchouc and the means of its production, we appear to have been indebted to some French Academicians, who were sent out for the purpose of astronomical observation in 1735: they discovered that it was a white milky juice of certain plants, found abundantly in Para in the Brazils, in Quito, and since found in Asia and several other places; a specimen of one of the trees was on the table. They grow so extensively in some places that hundreds of miles are covered with them: thus there is no fear of the material falling short of the demand. One of the first uses to which caoutchouc was applied appears to have been the well-known property of rubbing out black-lead pencil-marks, and hence probably originated the name, by which it is now better known in this country, of *India Rubber.*

The lecturer here read the following note from the London and Edinburgh Philosophical Magazine for January, 1833:

"Few persons are perhaps aware of the comparatively late introduc-

tion of Indian rubber into this country. The following notice is appended by Dr. Priestley to the Preface to his Familiar Introduction to the Theory and Practice of Perspective, printed in 1770; but it will be observed that no name is given to the substance described:—'Since this work was printed off, I have seen a substance excellently adapted to the purpose of wiping from paper the marks of a black-lead pencil. It must, therefore, be of singular use to those who practise drawing. It is sold by Mr. Nairne, mathematical instrument maker, opposite the Royal Exchange. He sells a cubical piece, of about half an inch, for three shillings; and he says it will last several years.'"

Most persons have seen the various forms in which caoutchouc is imported into this country, that is, either in large hard cakes or in the form of bottles; which last, it is possible, were originally made by the natives for the purpose of holding liquids. They formed these bottles by making a mould of clay, and then permitting the white milky juice to run all over its surface till there was a thin layer or coat; in this state it was held over a fire to dry, and hence its black colour, from the smoke: when dry it was covered with another coat of the juice, which was also dried, and so on till sufficient thickness was obtained. The clay was then removed from the inside by breaking it into fine powder, and permitting it to pass out of the neck of the bottle.

It being known that the original condition of the caoutchouc was the fluid state, solvents were sought and found. These are various—the essential oil of coal tar, the oil of sassafras, the essential oil of turpentine, and some others. It is also solvent in fat oils, particularly in those of almonds and olives. Professor Mitchel says that the most perfect of the solvents is the oil of sassafras, as it evaporates entirely, and the caoutchouc recovers all its qualities, whilst all the other solvents cause a greater or less change in its quality. The lecturer then showed and explained a great variety of fabrics which were on the table, in which there was one principle pervading the whole—that is, the warp, or longitudinal threads, were of caoutchouc, and the weft, or cross threads, were of cotton, silk, or linen, according to the object of the fabric. There was also a machine for making elastic braid, by covering a thread of caoutchouc with silk or other threads. The lecturer then explained that the threads of caoutchouc were produced by cutting it, by means of a machine, with the greatest evenness and equality. One pound will make a thread (known in the trade as No. 5) eight thousand yards in length, which was the average thickness of the thread used; but this thread, by the machine, might be again cut longitudinally into four, making in the whole 32,000 yards from one pound of caoutchouc; and such is the facility obtained by the machinery, that two girls are capable of cutting 30lbs. per day, producing 240,000 yards of No. 5 thread. In working threads of caoutchouc, it will be found that, if they are kept stretched for some length of time, and are exposed to cold, they become set to the length to which they have been stretched, and will no longer have elasticity; but by the application of heat, the threads will return to their original length and become again elastic; consequently, in weaving fabrics with warp-threads of caoutchouc, produced as before stated, the fabrics, when first woven, are not elastic, nor can they be extended to a greater length; and in order to obtain elasticity to such fabrics, a hot iron is passed over them, by which means the warp-threads of caoutchouc shrink back to their original length and then become elastic. In some instances where the elastic fabric would be liable to be extended

beyond the ultimate power of the elasticity of the caoutchouc, in place of having all the warp-threads of the elastic gum, alternate threads of cotton, silk, or linen are placed in the loom; by this means the fabric cannot be stretched beyond the ultimate power of elastic elongation of the caoutchouc, as the strain would then come on the warp-threads of cotton, silk, or linen, and prevent the fabric being further stretched.

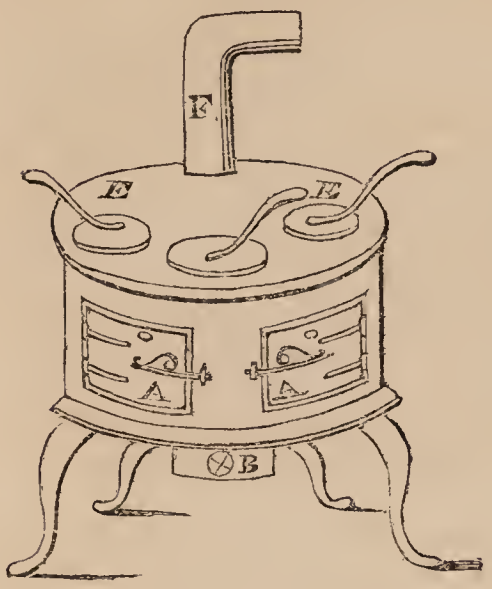
The lecturer spoke of the powers of distension of caoutchouc in reference to the blowing out bottles into balls and balloons, and mentioned some instances where a piece of the size of a walnut had been distended to the extent of fifty inches in diameter: the means pursued were to boil the material for an hour or two, and then to expand it by blowing. Within a few years the material sold for five and six shillings the pound; now any quantity may be had at a quarter that cost, even with the increased demand. The lecturer then mentioned a liquid which had been discovered by Messrs. Cornish and Co., but the nature of which was a secret, by which caoutchouc which is rotten and has lost its elasticity may be perfectly recovered in a few minutes. Mr. Brockedon concluded his very interesting and instructive lecture, by stating that the application of the material of which he had been treating was but in its infancy, although great strides had been made within a few years. Messrs. Cornish and Co., Mr. Sievier, Mr. Hancock, and some others to whom he had been indebted for information, were still going to great expense in a variety of new applications which he was not at liberty at present to mention.—*Repertory of Inventions.*

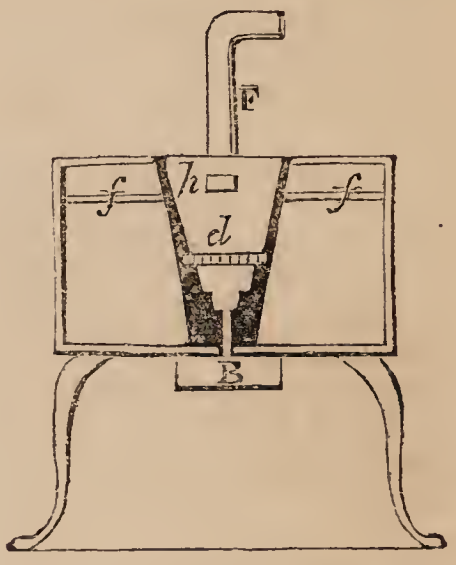
Zinc Milk Pails.—Among the patents lately taken out in America, one is for a process for extracting cream from milk by the use of zinc. It is said that if zinc be put into the milk pail, or the milk be put into a vessel made of that substance, the same quantity of milk will yield a greater proportion of cream or butter.—*Repertory of Inventions.*

New Zealand Flax.—Dr. Hooker, of Glasgow, has published an account of *Phormium Tenax*, or New Zealand Flax, with a figure of the plant. It seems hardy, for it has withstood the winter of Inverness-shire, in the open border, and has lately flowered near Birmingham. But what we deem most important is, that the trade in this flax with the New Zealanders is greatly increased of late years. According to the statistical returns of New South Wales for 1828, only 60 tons, valued at 2,600*l.*, were exported from Sydney to Britain during that year; while during 1830 (according to returns taken from the custom-house books) the quantities stated as the imports into Sydney for the English market were 841 tons, and in 1831 no fewer than 1,062 tons. Its present price in London may be stated at from 15*l.* to 25*l.* per ton, its quality and price varying. The flax is prepared by the natives, and in strength of fibre, and also in whiteness, far exceeds any analogous material; so that for cordage and canvass it is invaluable.—*Repertory of Inventions.*

The Bruges Stove.—By this stove a joint of meat may be roasted, two good-sized pies baked, a pudding, and two sorts of vegetables boiled, and sufficient room and heat left to prepare half a dozen sorts of sauces or gravies, all at one and the same time, with an expenditure of 6lbs. of coke and 2lbs. of coal, the value of which would not exceed *one penny*. The oven, too, remains in a state to bake any other articles, when the pies and meat are withdrawn. At this rate, the cost of roasting a leg of mutton would not exceed *one farthing*. This stove is portable, requires no setting, and may be placed in any apartment where there is a chimney or

flue for the reception of the funnel. The following sketches, the one a perspective view, and the other a section, will at once explain the manner of its construction. A A are two doors to the oven, which is heated by a conical furnace (*d*) in the centre; this furnace becomes after a time,





red hot, or at least sufficiently so to furnish heat for roasting. The hot air and smoke pass off from the furnace through the aperture *h*, and are made to circulate round the oven by means of the flue *f f;* after which they escape by the funnel F in the atmosphere or chimney of the room where the stove is placed. The conical shape of the furnace, besides being that which on scientifical principles is best suited to combustion, is attended with this advantage, that by having two or three movable grates, of sizes corresponding to the conical diminution, you can increase or diminish the fire at pleasure. The furnace as made by Messrs. Cottam and Hallen, has three ledges for this purpose, but this it will be seen is not necessary, and as receptacles for dust they are objectionable. B is the ash-drawer, and in front of this there is an aperture for conveying a stream of fresh air to the furnace. C and E E are saucepans inserted in the top of the oven; the first directly over the fire, and the two others over the smoke-flue *f*. The roasting and baking are done in the space round the furnace.—*Abridged from Loudon's Encyclopædia of Cottage Architecture.*

Bleaching Ivory.—Antique works in ivory that have become discoloured may be brought to a pure whiteness by exposing them to the sun under glasses. It is the particular property of ivory to resist the action of the sun's rays, when it is under glass; but when deprived of this protection, to become covered with a multitude of minute cracks. Many antique pieces of sculpture in ivory may be seen, which although tolerably white, are at the same time defaced by numerous cracks: this defect cannot be remedied; but in order to conceal it, the dust may be removed which has insinuated itself into the fissures, by brushing the work with warm water and soap, and afterwards placing it under glass. Antique works in ivory that have become discoloured may be brushed with pumice stone, calcined and diluted, and while yet wet placed under glasses. They should be daily exposed to the action of the sun, and be turned from time to time, that they may become equally bleached; if the brown colour be

deeper on one side than the other, that side will of course be for the longest time exposed to the sun. The bleaching may be accelerated by frequently repeating the operation just described.—*From the Danish of L. Spengler, in the Repertory of Arts.*

MISCELLANIES.

LIST OF PATENTS SEALED IN 1833.

Dyeing.—W. Greatrix, of Salford, silk dyer, for an improved method of imparting to various woven fabrics, the colour necessary to form the required patterns thereon.—Jan. 5.

Steam Engine.—J. Reynolds, of Oakwood, near Neath, iron-master, for an improved engine and apparatus to be worked by steam and other motive power.—Jan. 9.

Looms.—W. T. Shallcross, of Holt Town, Manchester, mechanic, for improvements in looms or machines for weaving cotton, linen, silk, woollen, &c.—Jan. 9.

Steam Engines.—S. Hall, of Basford, Nottinghamshire, cotton-manufacturer, for an improved method of lubricating the pistons, piston-rods, and valves or cocks of steam-engines, and of condensing the steam of such engines as are worked by a vacuum produced by condensation; also a method of condensation applicable to other useful purposes.—Jan. 9.

Dressing Flax.—J. Gibbs, of the Kent-road, Surrey, engineer, for certain improvements in the processes of dressing or preparing hemp, flax, New Zealand flax, &c.—Jan. 9.

Dressing Flax.—T. M. Evans, of Birmingham, merchant, for improvements in machinery for preparing and dressing flax, hemp, &c.—Jan. 10.

Coffee-Making.—S. Parker, of Argyle-street, Middlesex, bronzist, for improvements in apparatus for making extracts from coffee, &c.—Jan. 11.

Paper-Making.—W. Harrold, of Birmingham, merchant, for improvements in machinery for manufacturing paper.—Jan. 11.

Steam-Boilers.—W. Hancock, of Stratford, Essex, engineer, for improvements upon steam-boilers.—Jan. 15.

Blowing Machine.—A. Clark, of Bagilfe, Flintshire, for improvements in blowing-machines.—Jan. 15.

Elasticity.—R. W. Sievier, of Southampton-row, Bloomsbury, for improvements in manufacturing elastic goods.—Jan. 17.

Excavating.—T. Affleck, of Dumfries, for improvements in machinery for deepening and excavating the beds of rivers, removing sand-banks, bars, &c.; to extend to the Colonies and Plantations abroad.—Jan. 19.

Bridge-Building.—J. Macdonald, of the University Club House, Pall Mall East, gentleman, for improvements in the construction of bridges made of iron or other materials.—Jan. 22.

Navigation.—J. M'Curdy, of Southampton-row, for improvements in machinery for acquiring power in rivers and currents.—Jan. 22.

Bread Machinery.—L. Hebert, of Paternoster-row, civil engineer, for improvements in machines for manufacturing bread, &c.— Jan. 24.

Metallic Coating.—J. Warner, the younger, of the Crescent, Jewin-street, London, brass-founder, for improved processes in giving a metallic coating.—Jan. 24.

Locomotive Engine.—R. Stephenson, of Newcastle-upon-Tyne, engineer, for improvements in locomotive steam-engines.—Jan. 26.

Rooffing.—W. North, of Stangate-wharf, Lambeth, slater, for an improvement in roofling or covering buildings.—Jan. 29

Iron Manufacture.—J. S. Dawes, of Badford Works, West Bromwich, iron master, for improvements in the manufacture of iron.—Jan. 29.

Oil Gas.—R. Butler, of Austin-friars, London, merchant, for improvements in obtaining oil from certain substances ; and in obtaining gas from the same.—Jan. 29.

Steam Engines.—E. Appleby, of Doncaster, iron-founder, for improvements in steam-engines.—Jan. 29.

Railway Carriages.—J. Reedhead, of Henry-street, Lambeth, Esq., for improvements in the construction of railway carriages.—Jan. 29.

Steam Boilers.—J. Linton, of Selby, brazier, for an improved construction of steam-boilers.—Jan. 29.

Iron Manufacture.—J. J. Guest, of Dowlais Iron Works, Merthyr Tidvil, Esq., for an improvement in the process used for reducing iron ore.—Jan. 31.

Chairs.—J. Lutton, of Dean-street, Soho, Middlesex, chair-maker, for improvements in easy chairs.—Jan. 31.

Coal Gas.—J. Dickson and J. Ikin, of Holland-street, Blackfriars-road, engineers, for improvements in making gas from coal.—Feb. 6.

Bobbin-Net.—W. Crofts, of Radford, Nottingham, mechanic, for improvements in machinery for manufacturing bobbin-net lace.—Feb. 11.

Bobbin-Net.—W. Crofts, of Radford, Nottingham, mechanic, for an improved mode of combining together and actuating certain parts of machinery already known and used for making bobbin-net.—Feb. 11.

Pump.—E. Lucas, of Edward-street, Birmingham, engineer, for a self-acting force and lift pump.—Feb. 11.

Capstans.—J. Brown, of Margaret-street, Commercial-road, rigger, for improvements in capstans and apparatus to be used therewith.—Feb. 14.

Bricks.—W. Rhodes, of the Grange, Leyton, Essex, brickmaker, for an improved manufacture of bricks,—Feb. 14.

Artificial Skins.—T. R. Williams, Esq., late of Norfolk-street, Strand, for a new combination of fibrous materials, forming by means of machinery artificial skins.—Feb. 14.

Steam Engines.—L. Hebert, of Hampstead-road, civil engineer, and J. Don, of No. 9, Lower James-street, Golden-square, for improvements in machinery in the construction of steam-vessels and steam-carriages.—Feb. 21.

Steam Engines.—T. Hills, the younger, of St. Michael's-alley, Cornhill, gent., for improvement in furnaces for steam-boilers.—Feb. 21.

Steam Engines.—A. Gordon, of the Strand, engineer, for improvements in the boilers or generators of steam or vapour, and in condensing the same steam or vapour, and in steam-engines for carriages and vessels.—Feb. 21.

Baking Bread.—R. Hicks, of Wimpole-street, Middlesex, Esq., for an improved apparatus for baking bread.—Feb. 21.

Bobbin-Net.—H. W. Nunn, of Whippingham, Isle of Wight, bobbin-net lace manufacturer, G. Mowbray, of the same place, and R. Alabone,

of Newport, Isle of Wight, for improvements in the machinery used in the manufacture of bobbin-net, for producing embroidered or ornamented lace.—Feb. 27.

Steam Engine.—J. Thompson, of the London Iron and Steel Works, for improvements in the steam-engine.—Feb. 27.

Percussion Locks.—C. Jones, of Birmingham, gun-maker, for improvements upon percussion locks applicable to fire-arms.—March 7.

Corn-Stack Stand.—J. Springall, of Oulton, iron-founder, for an improved corn-stack stand.—March 7.

Flour and Bread.—T. Don, of Lower James-street, Westminster, millwright and engineer, for improvements in machinery for the preparation of farinaceous substances, and making bread.—March 8.

Bobbin-Net.—W. Hewson, of Worcester, lace-manufacturer, for improvements in machinery for manufacturing bobbin-net.—March 14.

Gas-Meter.—M. Berry, of 66, Chancery-lane, mechanical draftsman, for improvements in making gas-meters.—March 19.

Lace-making.—W. Herbert, of Nottingham-park, Nottingham, lace-manufacturer, for improvements in wark machinery.—March 21.

Chains.—J. Horton, of Taylor's Dock, Birmingham, boiler manufacturer, for an improvement in the manufacture of wrought iron chains.—March 23.

Nail Making.—J. Joyce, New-road, St. Pancras, gentleman, for improvements in machinery for making nails.—March 28.

Raising Water.—J. White, of Southampton, engineer and iron-founder, for improvements in machinery to be worked by steam, applicable to raising water.—March 28.

Tanning.—C. Terry, of Shoe-lane, London, merchant, for improvements in producing leather from hides and skins.—March 28.

Heat.—J. O. N. Rutter, of Lymington, Southampton, wine-merchant, for an improved process for generating heat, applicable to the heating of boilers and retorts.—March 30.

Files.—W. Shilton, of Birmingham, machinist, for an improved apparatus or machine for cutting files and rasps.—April 3.

Carriages.—E. Boys, jun. of Rochester, gentleman, for a machine for preventing accidents with carriages in descending hills.—April 4.

Button.—G. Rogers, of Sheffield, merchant, and J. Tatam, of Hilton, county of Derby, gardener, for an improved button.—April 4.

Machinery.—J. Gibbs, of the Kent-road, Surrey, engineer, for improvements in machinery for exhibiting scenery, paintings, or certain pictures.—April 4.

Caloric Engine.—J. Ericsson, of Albany-street, Regent's-park, civil engineer, for an engine for producing motive power, whereby a greater quantity of power is obtained from a given quantity of fuel than heretofore.—April 4.

Looms.—C. M. H. Molinard, of Bury-street, St. Mary Axe, London, merchant, for improvements in looms.—April 9.

Marble-Working.—G. W. Wildes, of Coleman-street, London, merchant, for improvements in machinery for cutting marble and other stones, and cutting mouldings in grooves thereon.—April 15.

Bobbin-Net.—J. Smith, jun. and Francis Smith, both of Radford, near Nottingham, mechanics, for improvements in machinery for manufacturing bobbin-net.—April 15.

Wool-combing.—J. Noble, of Little Horton, Bradford, Yorkshire, worsted spinner, for a machine for combing wool.—April 25.

Power Looms.—A. Douglas, of Manchester, manufacturer, for improvements on power looms and the shuttles used therein.—April 30.

Axletrees.—C. Collinge, of Lambeth, engineer, for improvements in the making of axletrees.—May 2.

Caloric Engine.—C. Robinson, of Athlone, Ireland, for new or improved machinery for transfering caloric from aëriform or fluid bodies to other bodies of the like description.—May 2.

Buttons.—J. Holmes, of Birmingham, engineer, for an improvement in metallic shanks for buttons.—May 4.

Weaving.—H. Jones and T. Jones, of Marple, Chester, weavers, for a certain method of stretching cloth and keeping it even during the process of weaving, and of preserving the selvages thereof.—May 4.

Spinning.—W. Norvell, of Newcastle-upon-Tyne, engineer, for an improvement of machinery for making strands from the yarns and laying ropes by such machinery at one and the same time.—May 7.

Steam Carriage Boilers.—J. Fraser, of Bevis Marks, St. Mary Axe, London, engineer, for improvements in steam boilers.—May 7.

Crucibles.—T. Spinney, of Cheltenham gas engineer, for a new combination of materials for the manufacture of crucibles, melting pots, and fire bricks.—May 11.

Bobbin-Net.—L. P. Lefort, late of Grand Couronne, near Rouen, France, but now of Cornhill, London, merchant, for an invention of improvements in machinery for making bobbin-net.—May 17.

Weaving.—W. Graham, jun., of Glasgow, cotton spinner and power loom manufacturer, for an invention of a self-acting temple in weaving by power or hand loom.—May 22.

Metal Spoons.—J. Hayne, of Clerkenwell, silversmith, for improvements in the manufacture of metal spoons.

Draining Tiles.—R. Beart, of Godmanchester, miller, for improvements in making tiles for draining land, buildings, &c.

Spinning.—J. Jones, of Salford, machine-maker, for improvements in the making of rovings, spinning and doubling of cotton, silk, flax, &c.

Paper-making.—F. Molineux, of New Bridge Street, Blackfriars, gent., for improvements in machinery for making paper.

(The four preceding patents were granted between the 22nd of May and the 1st of June.)

Substitutes for Hemp and Flax.—G. Harris, of East Dulwich, Surrey, Esq., for a new method for reducing and preparing various vegetable substances, and for the manufacturing them into articles in general use, heretofore usually made from hemp and flax.—June 1.

Pumps.—J. Barton, of Goswell Road, engineer, for improvements in the construction and application of pumps and machinery for raising fluids.—June 1.

Paddle-Wheels.—G. Carter, of Nottingham Lodge, Kent, gent., for improvements in paddle-wheels.—June 1.

Preserving.—P. A. Angilbert, of Upper Charles-street, Northampton-square, Middlesex, gent., for improvements in preserving animal, vegetable, or other substances.—June 1.

Railways.—W. Jessop, of Butterley Hall, Esq., for improvements in constructing railways.—June 1.

Scarifier, or Harrow.—C. Madeley, of Gilson Hall, Coleshill, Warwick, for a scarifier or harrow.—June 6.

Fire-Arms.—C. Jones, of Birmingham, gunmaker, for a new arrangement of additions to and alterations in certain parts of gun and pistol locks.—June 12.

Cranes.—J. Caldwell, of the New Crane, Shadwell, Middlesex, coal-merchant, for improvements in cranes, vessels, and apparatus for delivering coals from shipping to wharfs, warehouses, wagons, or carts, without the employment of lighters as usual.—June 12.

Paper-Making.—T. Wrigley, of Bridge Hall Mills, near Bury, Lancaster, paper-maker, for an improved pulp-strainer in making paper.—June 20.

Railroads —J. Gibbs, of East Smithfield, engineer, and Augustus Applegath, of Crayford, Kent, calico-printer for their invention of improvements in the construction of railroads, bridges, jetties, and aqueducts.—June 20.

Evaporating.—A. Ure, of Charlotte-street, Bloomsbury, M.D., for an improved apparatus for evaporating syrups and saccharine juices.—June20.

Evaporating.—W. Newton, of Chancery Lane, for an improved apparatus for boiling, evaporating, and concentrating syrups for the production of sugar, and also of saline liquors, or for the crystallization of salt, which apparatas may also be employed in the process of distillation.—June 20.

Sugar-Refining.—C. Terry, of Shoe-lane, London, merchant, and W. Parker, of New Gravel-lane, Shadwell, merchant, for improvements in making and refining sugar.—June 26.

Oil-Refining.—C. Terry, of Shoe-lane, London, merchant, and W. Parker, of New Gravel-lane, Shadwell, merchant, for improvements in refining and purifying oils.—June 26.

Anchors.—J. Christopher, of New Broad-street, London, merchant, for improvements on anchors.—June 27.

Pins.—G. B. Brown, of New Broad-street, London, merchant, for improvements in machinery for making or manufacturing pins.—June 27.

Culinary Utensils.—C. P. Banks, of Bewdley, Worcestershire, brass founder, for an improvement in the manufacture of culinary and chemical utensils.—June 29.

Ship-Building.—A. Mitchell, of Brickfield, Ballymacarret, county of Down, Ireland, civil engineer, for a dock to facilitate the repairing, building, or retaining of ships, and other floating vessels.—July 4.

Bobbin-Net.—W. Crofts, late of Lenton, but now of Radford, Nottinghamshire, mechanic, for improvements in machinery for making bobbin-net.—July 4.

Cotton Spinning.—W. Newton, of Chancery-lane, London, civil engineer, for improvements in roving frames, for roving cotton, &c.—July 11.

Printing.—A. Applegath, of Crayford, Kent, calico printer, for improvements in letter-press and block printing, and in the machinery or apparatus for the same.—July 18.

Steam Boilers.—J. Squire, of Paddington Basin, engineer, and Francis Macerone, of Upper George-street, Bryanstone-square, for improvements on boilers for generating steam.—July 18.

Paper Making.—J. Livesey, of Bolton-le-Moor, Lancashire, paper manufacturer, for improvements in the preparation of hemp, flax, and other fibrous material for the manufacture of glazing, friction, and mangle bowls, paper-makers' felts, and other purposes.—July 18.

Steam Engines.—J. Petrie, of Rochdale, mechanist and engineer, for improvements in steam engines.—July 25.

Quinine.—J. Pelletier and J. A. Despres, of 11, Finsbury Circus, London, for improvements in manufacturing sulphate of quinine.—July 25.

Printing.—J. Kitchen, of Newcastle-upon-Tyne, printer, for improvements in printing presses.—July 25.

Anchors.—W. Rodger, of Norfolk-street, Strand, for improvement or improvements in anchors.—July 26.

Carriages.—D. Rees, of Brecon, South Wales, woollen manufacturer, for improvements on drags or apparatus to be applied to carriages.—August 7.

Railways.—R. Smith, of the Abersychan iron works, Trevithin, Monmouth, gent., and John Walkinshaw, of the same place, engineer, for an improved rail for railways.—Aug. 10.

Consuming Smoke.—W. Wigston, of the gas works, Salford, near Manchester, engineer, for improvements in apparatus for consuming smoke.—Aug. 12.

Wool-combing.—J. Bates, of Bishopsgate-street, London, merchant, for improvements in machinery for cleansing and combing wool.—Aug. 13.

Woollen Manufacture.—J. Dyer, of Trowbridge, engineer, for a machine for fulling, thickening, felting, and cleansing woollen cloth.—Aug. 13.

Fids.—F. S. Blake, of H.M. dock-yard, Portsmouth, shipwright, for an improvement in fids for the upper masts, running bowsprits, and jib-booms of ships and other vessels.—Aug. 14.

Steam Engines.—J. S. Russell, of No. 8, Stafford-street, Edinburgh, M.A., for improvements in the construction of vessels for sustaining the pressure of fluids, and in the boilers and machinery of steam engines, and in the manner of their application to locomotive purposes.—Aug. 14.

Hydraulics.—J. Read, of Regent-street, Middlesex, merchant, for improvements in machinery or apparatus for raising or forcing fluids.—Aug. 19.

Spinning.—W. K. Westley, of Salford, near Manchester, flax spinner, and Samuel Lawson, of Leeds, machine maker, for improvements in machinery for preparing, drawing, or roving hemp, flax, wool, &c.—Aug. 20.

Steam Carriages.—Sir C. W. Dance, of Hertsbourne Manor-place, Hertford, knt., lieutenant-colonel, and Joshua Field, of Lambeth, engineer, for improvements in locomotive carriages.—Aug. 20.

New Solvent.—W. H. Barnard, of 26, New Broad-street, London, gent., for a solvent not hitherto used in the arts.—Aug. 20.

Evaporating.—W. G. Kneller, of Mitcham, Surrey, chemist, for improvements in evaporation.—Aug. 24.

Malting.—Richard Else, of Bath, gent., for improvements in drying malt.—Sept. 7.

Steam Carriages.—W. Church, Bordesley Green, near Birmingham, gent., for improvements in steam carriages.—Sept. 7.

Steam Valves.—Isaac Dodds, of Horsley iron works, Tipton, Stafford, engineer, for an improved method of manufacturing valves for steam engines.—Sept. 14.

Bobbin-Net.—J. Heathcot, of Tiverton, Devon, lace manufacturer, for improvements in machinery for the manufacture of bobbin-net.—Sept. 14.

Cotton Spinning.—J. S. Howard, of Chow Bent, Lancaster, machine maker, for improvements in machinery called roving-frames, for roving cotton, &c.—Sept. 21.

Maladies of the Head.—L. Cournier, of Kennington Green, Surrey, gent., for an improvement in curing certain maladies of the head.—Sept. 21.

Polishing Furniture.—F. W. Williams, of Gilbert-street, Oxford-street, Middlesex, gent., for a composition for polishing furniture.—Sept. 21.

Spinning.—J. Robertson, of Crofthead, Neilston, and county of Renfrew, cotton spinner, for improvements in the mule jenny and the billy stretching frame, or other machine for roving of cotton, and in the machinery for spinning and roving of silk, wool, flax, hemp, &c.—Sept. 21.

Paper-Making.—H. Davey, of Camberwell, Surrey, gent., for improvements in machinery for preparing linen and cotton rags and other materials used in the manufacture of paper.—Sept. 28.

Door Springs.—A. Smith, of Princes-street, Leicester-square, machinist, for improvements in springs for doors.—Oct. 5.

Castors.—J. W. Lewty, of Lichfield-street, Birmingham, brass-founder, for improvements in castors.—Oct. 5.

Weighing Machines.—M. Berry, of 66, Chancery-lane, civil engineer, for improvements in the construction of weighing machines.—Oct. 5.

Cotton Spinning.—T. Welch, of Manchester, cotton spinner, for a new method of taking up, for power and hand-looms.—Oct. 5.

Towing.—W. T. Young, of Liverpool, merchant, for a machine for equalizing draft, chiefly applicable to the towing of barges and other floating bodies on water, and moving or drawing carriages on land.—Oct. 7.

Steam Boilers.—J. Maudslay, of Lambeth, Surrey, engineer, for an improvement in the structure of boilers in steam engines.—Oct. 7.

Musical Instruments.—G. Gurney, of Bude, Cornwall, Esq., for improvements in musical instruments.—Oct. 7.

Locomotive Engines.—R. Stephenson, of Newcastle-upon-Tyne, Northumberland, engineer, for improvement in locomotive steam engines.—Oct. 7.

Pencils.—R. B. Cooper, of Battersea Fields, Esq., and George Frederick Eckstein, of Holborn, ironmonger, for an instrument or apparatus for pointing pencils, &c.—Oct. 12.

Gas.—S. Hutchinson, of 12, Pall-Mall-East, for improvements in machinery for manufacturing gas for illumination, the mode of supplying gas, and the construction of gas-burners.—Oct. 12.

Gas-lighting and Heating.—R. Barnes, of Wigan, Lancaster, engineer, for a machine for producing, by the combustion of gas or oil, heated air for warming the interior of buildings, and which machine may be applied at the same time to give light.—Oct. 19.

Chlorine.—J. Tennant, merchant, and T. Clark, chemist, both of Glasgow, Lanark, for an improved apparatus to produce or evolve chlorine for manufacturing purposes.—Oct. 19.

Soda.—C. Attwood, of Wickham, near Gateshead, Durham, glass manufacturer, for improvements in manufacturing or purifying soda.—Oct. 19.

Silk Weaving.—J. F. V. Gerard, of Mile End, Middlesex, for an improvement applicable to the Jacquard looms for weaving figured fabrics.—Oct. 19.

Ordnance.—T. A. G. Gillyon, of Crown-street, Finsbury-square, engineer, for improvements in ordnance, and on the carriages and projectiles to be used therewith.—Oct. 19.

Dyeing.—H. Hendriks, of Dunkirk, France, but now of the Strand, gent., for improvements in manufacturing prussiate of potash and the prussiate of soda, and improvements in dyeing blue colours without indigo.—Oct. 19.

Nail-Making.—J. Joyce, of New Road, St. Pancras, gent., for improvements in machinery for making nails.—Oct. 19.

Steam Carriages.—D. Redmund, of Wellington Foundry, City-road, Middlesex, engineer, for improvements in steam carriages, &c.—Oct. 28.

Steam Boilers.—G. F. Muntz, of Birmingham, roller of metals, for an improved manufacture of steam boilers.—Oct. 28.

Block Printing.—C. J. Hullmandel, of Great Marlborough-street, Middlesex, printer, for improvement in block printing, as applied to calico and some other fabrics.—Oct. 28.

Metallurgy.—H. L. Pattinson, of St. John, Northumberland, for an improved method of separating silver from lead.—Oct. 28.

Piano-Fortes.—J. F. Zeitter, of New Cavendish-street, Middlesex, piano-forte maker, for improvements in piano-fortes and other stringed musical instruments.—Nov. 1.

Cotton Spinning.—J. Travis the Younger, of Shaw Mills, near Manchester, cotton spinner, for improvements in machinery or apparatus for spinning wool, cotton, hemp, flax, &c.—Nov. 1.

Excavating.—W. Brunton, of Charlotte-row, Mansion-house, London, engineer, for an apparatus to facilitate and improve the excavation of ground and the formation of embankments.—Nov. 2.

Fuel.—D. Strafford, of Duke-street, Adelphi, and late of Paris, for an improvement in fuel.—Nov. 2.

Machinery.—J. Wass, of Lea, Derbyshire, mill-wright and engineer, for certain mechanical powers, applicable to various useful purposes.—Nov. 5.

Steam Engines.—R. Holme, of Kingston-upon-Hull, for improvements in apparatus for generating steam, and in other parts of steam engines, and in the means of producing heat.—Nov. 5.

Building.—H. R. Palmer, of Eludyer-street, Westminster, civil engineer, for improvements in the construction of arches, roofs, and other parts of buildings.—Nov. 7.

Spinning.—Peter Ewart, of Manchester, cotton spinner, for improvements in the mule spinning machine.—Nov. 9.

Clock-making.—J. Pace, of Bury St. Edmunds, Suffolk, watch and clock maker (being one of the people called Quakers), for improvements in horological machines.—Nov. 14.

Steam Navigation.—R. W. Brandling, of Low Gosforth, Northumberland, Esq., for improvements in applying steam and other power to ships, boats, and other purposes.—Nov. 19.

Heat.—J. C. Douglas, of Great Ormond-street, Esq., for improvements in the construction of furnaces for generating heat, and in the construction of apparatus for applying heat.—Nov. 19.

Steam Boilers.—J. C. Douglas, of Great Ormond-street, Esq., for improvements which prevent the explosion or the collapse of steam and other boilers.—Nov. 19.

Silk Manufacture.—M. Roman, of St. Michael's-alley, Cornhill, merchant, for improvements in or additions to apparatus or methods employed in throwing or winding silk, &c.—Nov. 19.

Engine.—B. Richard Comte de Prédaval, of Leicester-place, Leicester-square, engineer, for an engine for producing motive power.—Nov. 19.

Pens.—S. Perry, of 25, Wilmington-square, Clerkenwell, gent., E. Massey, sen., of 20, King-street, watchmaker, and P. J. Gauci, of No. 10, Charles-street, Middlesex-hospital, artist, for improvements in pens and penholders.—Nov. 19.

Pins and Needles.—D. Ledsam and W. Jones, both of Birmingham, screw manufacturers, for improvements in machinery to be used in the manufacture of pins and needles.—Nov. 21.

Rectifying.—J. C. Douglas, of Great Ormond-street, Esq., for improvements for depriving vegetable juices and fermented and distilled liquids of their acid qualities, also of their colouring matter and essential oils.—Nov. 21.

Printing.—H. H. Leggett, of Fulham, gent., for improvements in the art of printing in colours.—Nov. 23.

Locks.—T. Parsons, of Newport, gent., for improvements in locks for fastenings.—Dec. 3.

Filters.—J. Hall, of Breezes-hill, Ratcliffe-highway, sugar-refiner, for improvements in filters for sugar and other liquids.—Dec. 6.

Flax.—J. Wordsworth, of Leeds, machine-maker, for improvements in machinery for heckling flax, hemp, &c.—Dec. 6.

Air Stoves.—E. Wolff, late of Leeds, merchant, but now of Stamford-hill, Middlesex, gent., for a mode of supplying stoves with heated air, without bellows or blowpipe.—Dec. 7.

White Lead.—J. B. C. Forassa, of Newington-causeway, Surrey, gent.; P. I. Muston, of Austin-friars, merchant; and H. W. Wood, of the same place, merchant, for improvements in making white lead.—Dec. 11.

Excavating.—T. Affleck, of Dumfries, merchant, for improvements in the machinery for deepening and excavating the beds of rivers, removing sand-banks, bars, and other obstructions to navigation.—Dec. 11.

Dressing Cloths.—R. Carr, of Sheffield, manufacturer, for improvements in machinery for cutting, cropping, and dressing woollen and cotton cloths.—Dec. 11.

Railways.—R. Stephenson, jun., of Hampstead, civil engineer, for an improvement in the mode of supporting the iron rails for edge railways.—Dec. 11.

Covers or Stoppers.—J. Wisker, of Vauxhall, Surrey, potter, for improvements in machinery for grinding covers or stoppers for jars, bottles, and other vessels made of China, stone, or other earthenware.—Dec. 11.

Machinery.—L. W. Wright, of the London-road, Southwark, for improvements in machinery, or in apparatus whereby certain well-known agents may be employed in producing power.—Dec. 16.

Propelling.—T. Sunderland, of Blackheath, Esq., for improvements in propelling vessels.—Dec. 19.

Locks.—C. Chubb, of St. Paul's Churchyard, London, and E. Hunter, of Wolverhampton, locksmith, for improvements in locks.—Dec. 20.

Trigonometrical Instruments.—D. Rowland, of Crawford-street, Marylebone, mechanic, for an improvement in the manufacture of sextants, quadrants, circles, and other instruments used in taking observations and surveys.—Dec. 20.

Carriages.—L. Quaintin, of Leicester-square, carriage builder, for improvements in the construction of carriages.—Dec. 20.

Sawing and Boring.—J. Hamilton, of Threadneedle-street, London, civil engineer, for improvements in machinery for sawing, boring and manufacturing wood.—Dec. 20.

Rotatory Engines.—Thomas, Earl of Dundonald, for improvements in the construction and operation of rotatory engines and apparatus connected therewith.—Dec. 20.

Bolts and Latches.—J. G. Pierson, of New York, United States, but now of Ludgate-hill, London, merchant, for improvements in the construction of bolts and latches.—Dec. 20.

Tanning.—J. P. Newman, of Cornhill, London, merchant, for improvements in making leather from hides and skins.—Dec. 21.

Steam Navigation.—J. H. Kyan, of Upper Baker-street, Esq., for a new combination of machinery to be applied to the present purposes of steam navigation.—Dec. 21.

Paper-Making.—G. Dickinson, of Buckland, near Dover, paper-maker, for improvements in making paper.—Dec. 22.

SCIENTIFIC BOOKS PUBLISHED IN 1833.

Abercrombie's Philosophy of Moral Feelings—Ægineta's (Paulus) Medical Works, transl. by Adams, vol. 1.—Airy's Astronomical Observations at Cambridge, 1832.—Alexander's (Alex.) Treatise on the Nature of Vision, &c.—Arago's Notices of Comets, transl. by Gold.—Asiatic Researches, vol. 17.—Badnall on Railway Improvements.—Bakewell's Philosophical Conversations.—Ballard's Treatise on Trees, &c.—Bell's (G. H.) Treatise on the Liver, &c.—Bell (And.) Mathematical and Physical Tracts.—Bennett's Fishes of Ceylon, complete.—Berzelius' Analysis of Inorganic Bodies, transl. by Rees.—Bloxam's Surgical Anatomy of Hernia.—Bonaparte's American Ornithology, vol. 4.—Book of Science.—Bos's Grecian Antiquities, transl. by Barber.—Bowditch's Le Place's Mecanique Celeste, vol. 1 and 2.—Brande's Table of Chemical Notation.—Brett's Principles of Astronomy, part 2.—Bridgewater Treatises: Whewell's Astronomy.—Bell on the Hand.—Brindley's Compendium of Civil Architecture.—British (The) Cyclopædia (Arts and Sciences) vol. 1.—Brown's (Tho.) Zoologist's Text Book, 2 vols.—Taxidermist's Manual; Conchologist's Text Book.—Bushman's Case in which Animals were found in Venous Blood.—Cambridge Mathematical Papers, (Supplement to Part 2.)—Castle's Synopsis of Medical Botany.—Clarke's (T. H.) Domestic Architecture of Elizabeth and James I.—Cobbett's English Gardener.—Cocks' Illustrations to Cooper's Surgical Dictionary, vol. 1.—Coney's Etching of Architectural Sketches.—Coney's Architectural Beauties of Continental Europe.—Cooper's (B. B.) Surgical Essays.—Cundy on Inland Transit and Railroads.—Curtis's Physiology and Diseases of the Eye,—Cuvier's (Baron) Memoirs, by Mrs. Lee.—Cuvier's Animal Kingdom, (Annelida, &c.)—Dallaway's Discourses on English Architecture.—Dissertation on the Antiquity, &c. of the Pyramids of Egypt.—Dissertation on the Nature of Soils and Manure.—Dodwell's Views of Cyclopean or Pelasgic Remains.—Donaldson's Examples of Door ways.—Duncan's Elements of Plane Geometry.—Encyclopædia Americana, complete in 13 vols.—Encyclopædia Metropolitana, vol. 3, (3rd Division.)—Fairholme's View of the Geology of Scripture.—Forbes' Hortus Woburnensis.—Forster's Medicina Simplex.—Forsyth's Dictionary of Diet, &c.—Galt's (John) Ouranoulogos, illustrated by Martin, Part 1.—Gaulter's Origin, &c. of Cholera in Manchester.—George's Compendious History of Small Pox.—Giles's Young Artist's Preceptor.—Goodwin's Domestic Architecture, Part 1.—Granville's Graphic Illustrations of Abortion, &c.—Graves and Morrie's Hortus Medicus, Part 1.—Gray's Entomology of Australia, Part 1.—Guthrie on Inguinal and Femoral Herniæ.—Hahnemann's Homœopathic Medical doctrine, by Devrient.—Hall's (W. S.) Tables of Land Measures, &c.—Hall's (T. G.) Treatise on Plane Trigonometry.—Hann and Dodd's Mechanics for Practical Men.—Haughton's Bengali and Sanskrit Dictionary.—Herschel's (Sir J.) Treatise on Astronomy.—Hogg on the Carnation, (Supplement to)—Irish (The) Flora.—Jackson's Observations on

Lakes.—Jones' (T. W.) Manual of Pharmacology.—Jopling's Practice of Isometrical Perspective.—Key on Stricture in Strangulated Hernia.—Lambert's Description of the Genus Pinus, 2 vols.—Lardner's Cabinet Cyclopædia, vols. 39 to 50.—Lee's (Edwin) Treatise on Nervous Disorders.—Lee (Alex.) Chemical Diagrams.—Lee (Rob.) Researches on Diseases of Women.—Lee (Mrs.) Memoirs of Baron Cuvier.—Library of Useful Knowledge: Animal Physiology.—Roget's Treatise on Electricity, &c.—Lindley and Hutton's Fossil Flora of Great Britain, vol. 1. Part 2.—Lindsay's Introduction to Astronomy.—Lindsay's Summary of General Geography.—Loudon's Encyclopædia of Cottage, &c. Architecture.—Lyell's Principles of Geology.—Macfarlane's Cotton Yarn Price Book.—Macgrigor on the Orbits of Comets and Planets.—Macilwain's Origin of Porrigo.—Macilwain's Diagnosis of Hernial Tumours.—Macneill on Resistance of Water in the Passage of Boats on Canals.—Macneill's Tables for calculating Earth-work in cutting and embankment of Canals.—Main's Vegetable Physiology.—Malte Brun's Geography, complete, 9 vols.—Mansart's Dialogues sur les Beauz Arts, &c.—Mantell's Geology of the South-east of England.—Memoirs of Dr. J. Priestly, by himself.—Mirbel's Botanical Geography, transl. by Parkinson.—Miscellany of Natural History, by Lauder, vol. 1. (Parrots.)—Mudie's Guide to the Observation of Nature.—Narrien's Origin and Progress of Astronomy.—Natural History; Introduction to the Study of Quadrupeds.—Naturalist's Poetical Companion.—Naturalist's (The) Library, by Jardine, vol. 1, 2, and 3.—Needham's Observations on the Cholera in York.—New London Chemical Pocket Book, by Barnes; Surgical, ditto.—Newman's (E. M.) Analysis of Sounds.—Newton's Principia, by Le Seur and Jacquier, 2 vols.—O'Brien's (H.) Round Towers of Ireland, or the Mysteries of Freemasonry, &c., unveiled.—Otto's Treatise on the Violin, &c.—Parnell's Treatise on Roads.—Philosophical Trans. of the Royal Society, 1833, Part 1.—Philosophical Trans. (Abstracts of Papers) 1800 to 1830.—Porter's (G. R.) Tropical Agriculturist.—Proceedings of the British Association for Advancement of Science at York, 1831, and and Oxford, 1832.—Pugin and Wilson's Gothic Architecture, 2nd series, Part 3.—Readings in Science.—Redding's History of Modern Wines.—Rennie's Alphabet's of Angling, Botany, Chemistry, Gardening, Physics, and Zoology.—Richardson's Mercantile Marine Architecture.—Ritchie's Principles of Geometry.—Robertson's (J. Supplement to Loudon's Cottage Architecture.)—Robinson's (P. F.) Vitruvius Britannicus, Part 2.—Robinson's Park Entrances and Gate Lodges, complete.—Rodham's Treatise on Land Surveying.—Roupell's Croonian Lectures on Cholera.—Roupell's Illustrations of the effects of Poisons, Part 1.—Royle's Botany of the Himalayan Mountains, &c. Part 1.—Russell's (Jas.) Observations on the Testicles.—School (The) and Family Manual, vol. 1. (Geometry). Vol. 2, (Arithmetic, Part 1.)—Scrope on Political Economy.—Selby's British Ornithology, Vol. 2. (Water Birds.)—Smith's (J. E.) English Flora, Vol. 5.—Smith (John) On the Artificial Growth of Cucumbers, &c.—Swan's Demonstration of the Human Body, Part 3.—Syllabus of Lectures on Trigonometry.—Thompson's (A. T.) Elements of Materia Medica, Vol. 2.—Thompson's (J.) First Six, Eleventh and Twelfth Books of Euclid.—Transactions of the Royal Asiatic Society, Vol. 3, Part 2.—Camb. Phil. Soc., Vol. 4, Part 3.—Horticul. Society, Vol. 1. Parts 3 and 4.—Linnæan Society, Vol. 16, Part 3.—Zoolog. Soc. Vol. 1, Part 1.—Medico-Chirurgical Society, Vol. 18. Part 1.—Edinb. Royal Society, Vol. 12, Part 1.—Provincial Med. and Surg. Association,

Vol. 1.—Med. and Physical Soc. at Calcutta, Vol. 6.—Trendall's Interior Finishings for Houses.—Turnbull on the Five Archit. Sections of Cast Iron Beams.—Twining's Account of the Epidemic Cholera.—Ditto Clinical Illustrations of Diseases in Bengal.—Walker's (R.) Flora of Oxfordshire, &c.—Wallace's (John) Treatise on Dendrology.—Whewell's Analytical Statics.—White's Selborne for the Use of Young Persons.—Whitlaw's New Medical Discoveries, 2 vols.—Ditto, Treatise on Inflammation, &c.—Wickham on Diseases of the Joints.—Witham's Internal Structure of Fossil Vegetables.—Witt's Compendium of Osteology.—Woodward's Outline of the Geology of Norfolk.—Young's Trigonometry.—Ditto, with Mathematical Tables.—Mathematical Tables.—Young (S.) Cotton Spinner's and Mechanic's Arithmetic.—*From Bent's List.*

The Nautical Almanac for 1834—the first which has been brought out under the direction of the present superintendent, Lieutenant Stratford contains the following valuable improvements :—1. The moon's place is given, for every hour of the day, while formerly it was limited to noon and midnight ; 2. The places of the four bright planets, which were heretofore given for every seven days, are now given for every day ; and 3. The lunar distances from the planets are now given, as well as those from the fixed stars. The price, at the same time remains as before.—*Mechanics' Magazine.*

OBITUARY OF PERSONS EMINENT IN SCIENCE AND ART, 1833.

Frederick Kœnig, inventor of the mechanical presses, upon an entirely new principle, which he, in conjunction with his friend Bauer, of Wirtemberg, first brought into use for the *Times*, of London. The steam presses of the *Augsburg Gazette* were also constructed by them. For the last fourteen years they had an extensive manufactory at Oberzell.

Dr. Hermbstadt, Professor of Chemistry, at Berlin.

Edward Collins Giddy, Esq., Curator of the Cornwall Geological Society's Museum.

Mr. Trevithick, the distinguished engineer, who, says the *Mechanics' Magazine*, may justly be regarded as the father of steam locomotion in England.

B. Bevan, Esq., Engineer of the Grand Junction Canal Company, author of the *Treatise on the Slide-Rule*, &c. We extract the following interesting notice of his last moments from a letter from Mr. William Andrews, of Ivanhoe, Bucks :—" On Monday (July 4), in the evening, Mr. Bevan attended a public meeting of the inhabitants of the town ; at night he was taking observations of the eclipse of the moon : during the eclipse, he called Mrs. Bevan to witness the beautiful sight ; but almost immediately after, he was taken suddenly ill, and in a few minutes was a corpse."—*Mechanics' Magazine.*

James Jennings, Esq., an industrious writer on ornithology.

Adrian Hardy Haworth, Esq., an indefatigable writer on entomology and botany, and more than thirty years a contributor to various works in those branches of natural science. His memory is honoured by genera and species being called after his name. (See No. 46 of the *Gardener's Magazine* for many interesting particulars of the life of this excellent man and amiable philosopher.) His museum contains about 40,000 insects, arranged in cabinets ; with a select collection of crustaceous radiata, corallines, fishes, &c. ; about 20,000 dried plants, and a considerable collection of living succulent plants.

Capt. George Lyon, honourably distinguished in the Polar expeditions of the present century.

Joshua Brookes, Esq., the celebrated anatomist.

Dr. Babington, who formed, as it were, the connecting link between the departed and living philosophers of the last half century—from Priestley down to Wollaston and Davy.

Mr. Charles Antony Boner, a distinguished mathematician, and inventor of a quadrant of reduction.

Godfrey Higgins, Esq., author of "Celtic Druids."

Augustus Pugin, Esq., architect.

G. F. Robson, Esq., the popular artist.

Dr. John Gordon Smith, an eminent writer on Forensic Medicine.

John Thomas Smith, Esq., pupil of Roubiliac, the sculptor.

Note *to Mr. Galloway's Paper on the application of Steam expansively in Cornish Steam-engines.* (Page 41 to 47.)

Mr. Galloway attributes to Hornblower, in 1781, the discovery of the method of working steam-engines by the expansive action of steam continuing the motion of the piston, after the communication from the boiler to the cylinder is cut off.—(See page 43.) Mr. Farey has communicated to the *Repertory of Arts*, that Mr. Watt had fully conceived the expansion principle so early as 1769, as is proved by a letter of this date from Watt to Dr. Small at Birmingham. The passage shows a full knowledge of the principle of expansive action, and Mr. Watt applied it to practice in the engine at the Soho Works, in 1776, and in the engine at Shadwell Water Works, London, in 1778. Mr. Hornblower's invention, patented in 1781, was the use of two cylinders in carrying Mr. Watt's previous invention of expansive action into effect; and there is no statement whatever in Mr. Hornblower's specification, announcing the principle of expansive action, as his invention or discovery. Mr. Watt's subsequent patent of 1782, was for various contrivances in applying his principle; neither these nor Mr. Hornblower's two cylinders have come into use; but the original plan adopted by Mr. Watt in the engine at Soho, in 1766, has been followed to the present day, without alteration, in the engines made by Messrs. Boulton and Watt.

Another statement requiring correction in Mr. Galloway's paper, is, that the best engines by Boulton and Watt, are estimated as capable of raising 19,800,000lbs. per bushel of coals, which number is adopted for a term for comparison with an extraordinary performance of the best modern engine. The fact is, that 19·8 millions is the average performance of about twenty-seven engines in Cornwall, taken during the whole of the years 1813 and 1814, when Mr. Watt's system was universally followed; and a corresponding two years' average of the performance of the engine at Wheal Towan, viz. 1828 and 1829, is 76·76 millions, which is far below the very extraordinary performance of 125,749,330. The statement of eight cubic feet of water being converted into steam by a bushel of coals is liable to the same objection, that being the very lowest performance of badly managed engines: good boilers of Mr. Watt's construction, will evaporate ten cubic feet for an average performance.

MEETINGS OF THE SCIENTIFIC AND LITERARY INSTITUTIONS OF LONDON FOR 1833—34.

Societies.	Times of Meeting	November.	December.	January.	February.	March.	April.	May.	June.
Royal Society	Thur. 8½ P. M.	14, 21	5, 12, 19	9, 16, 23, 30	6, 13, 20, 27	6, 13, 20, 27	17, 24	1,8,15,22, 29	5, 12, 19
Society of Antiq.	Thur. 8 P. M.	14, 21, 28	5, 12, 19	9, 16, 23, 30	6, 13, 20, 27	6, 13, 20, 27	17, 24	1, 8, 15, 22, 29	5, 12, 19
Royal Institution	Fri. 8½ P. M.	..	..	17, 24, 31	7, 14, 21, 28	7, 14, 21,	18, 25	2,9,16,23,30	6, 13
Royal Geographical Society	Mon. 9 P. M.	11, 25	9, 23	13, 27	10, 24	10, 24	7, 21	12, 26	9, 23
GeologicalSociety	Wed. 8½ P. M.	6, 20	4, 18	8, 22	5, 26	12, 26	9, 23	7, 21	4
Linnæan Society	Tues. 8 P. M.	5, 19	3, 17	14	4, 18	4, 18	1, 15	6, 20	3, 17
Horticul. Society	Tues. 1 P. M.	5	3	21	4,18	4,18	1.15	6,20	3, 17
Zoological Soc.	Thur. 3 P. M.	7	5	2	6	6	3	1	5
Zoological Soc. *	Tues. 8½ P.M.	12, 26	10, 24	7, 21	11, 25	11, 25	8, 22	13, 27	10, 24
Astronomical Soc.									
Phrenolog. Soc.	Mon. 8 P. M.	4, 18	2, 16	6, 20	3, 17	3, 17	7, 21	5, 19	2, 16
Society of Arts	Wed. 7½ P. M.	6,13,20,27	4, 11, 18	8, 15, 22, 29	5, 12, 19, 26	5, 12, 19, 26	2,9,16,23,30	7, 14, 21, 28	4, 11
Royal Society of Literature	Wed. 3 P. M.	6, 20	4, 18	1, 15	5, 19	5, 19	9, 23	7, 28	11, 25
RoyalAsiatic Soc.	Sat. 2 P. M.	..	7	4, 18	1, 15	1,15	5, 19		7, 21
Medico-Botanical Society									July 5,19
Medico-Chirurgical Society	Tues. 8½ P. M.	12, 26	10	14, 28	11, 25	11, 25	8, 22	13, 27	..
Medical Society	Mon. 8 P. M.	4,11,18,25	2,9, 16,23	6, 13, 20, 27	3, 10, 17, 24	3, 10, 17, 24	7, 14, 21, 28	5, 12, 19, 26	..
Westminster Medical Soc.	Sat. 8 P. M.	2,9,16,23,30	7, 14, 21	4, 11, 18,25	1, 8, 15, 22	1, 18, 15, 22	5, 12,19, 26	3, 10, 17, 24	..
Institution of Civil Enginr.	Tues. 8 P. M.	..	..	7, 14, 21, 28	4, 11,18,25	4, 11, 18, 25	1,8,15,22,29	6, 13, 20, 27	3

* Scientific Business.

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